1.2 Forest Type, Size Class, Age Class, and Succession Stages

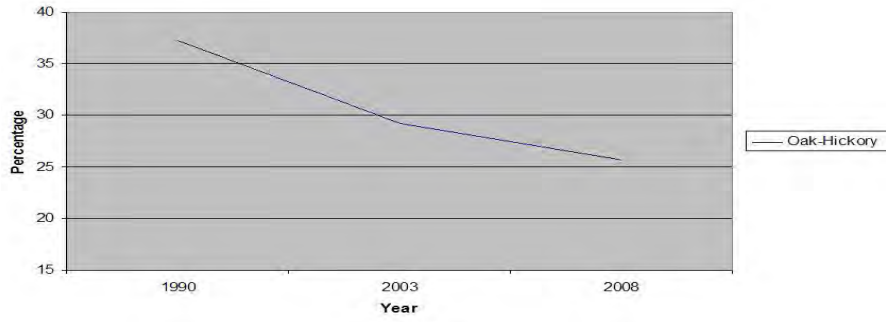
Forest Cover Type

Iowa forests are 98% hardwoods; white pine, eastern red cedar, and balsam fir are the only conifers native to Iowa, with white pine and balsam fir confined to the northeastern part of the state. Tree species diversity is highest in eastern Iowa and decreases to the west. Due to the prevalence of wildfire prior to statehood, most trees in the state today are fire-adapted species; however, with the suppression of fire that accompanied Iowa's settlement, thinner-barked shade-tolerant trees have been able to grow within the dominant oak-hickory forest type.

The oak-hickory forest type is the largest in Iowa. However, there has been a decline in this forest type in recent years, from 37% of total forest area in 1990 to 26% in 2008.

Iowa's state tree is the oak, though it is not specific which of the eleven oak species native to the state the official type is. White and bur oak trees are typically the oldest living species, with some exceeding 400 years in age. Oaks are disturbance dependent species, meaning that they have a competitive advantage over other trees in areas susceptible to fire. The oak-hickory forest type is the largest in Iowa; however, as Figure 1.31 below demonstrates, there has been a decline in this forest type in recent years, from 37% of total forest area in 1990 to 26% in 2008 (See Appendix E for a complete breakdown of forest types according to USDA-FS-FIA inventories for 1990, 2003 and 2008). Lack of active management and disturbance on private and public forest lands are the leading causes of oak-hickory forest decline in Iowa.

Figure 1.31 Percentage of Oak-Hickory Forest Type in Iowa's Forests.



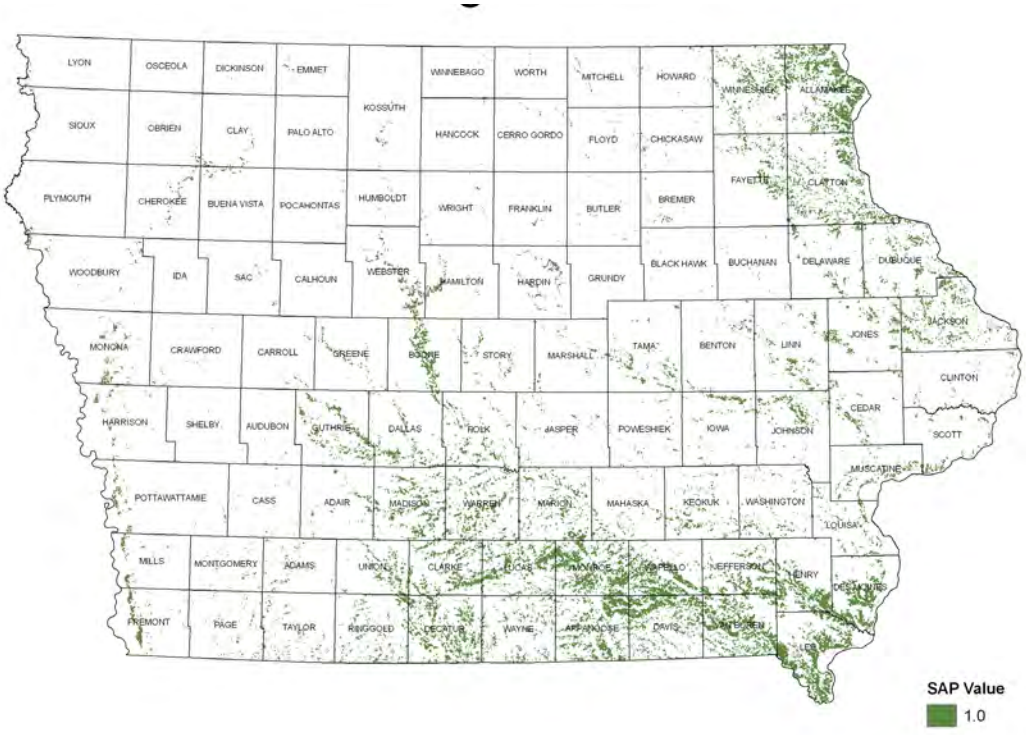
Miles, P.D.

Oak Regeneration

Figure 1.32 shows areas of the state for which oak-hickory management is a high priority. These areas are relatively easy to manage because of their high concentrations of oak trees. Areas that have lost their oak-hickory component have transitioned to other, shade-tolerant, species are much harder to restore to oak-hickory. While it is important to ensure that the latter areas remain as forests, the sheer amount of resources that would be necessary to restore them to oak-hickory forests makes such a task virtually impossible.

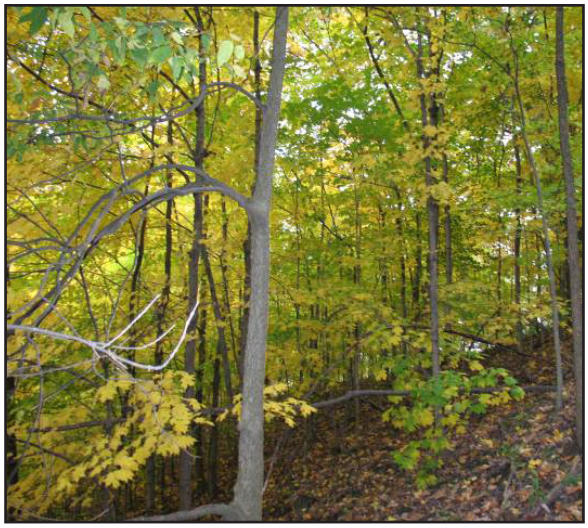
Since 1954, Iowa has been losing over 7,000 acres of oak-hickory forest annually.[16] Managing native vegetation communities in Iowa is a challenge because of the state's highly fragmented forests and near-complete removal of historical disturbance regimes like fire. Active forest management is now needed to help oaks adequately regenerate in Iowa's maturing forests; whenever possible, the DNR Forestry Bureau actively manages oak in state forests using even-age silvicultural techniques.

Figure 1.32 Priority Areas for Oak Regeneration.



Source: Kathryne Clark using FIA data and satellite land cover from 2002.

[16]Miles.



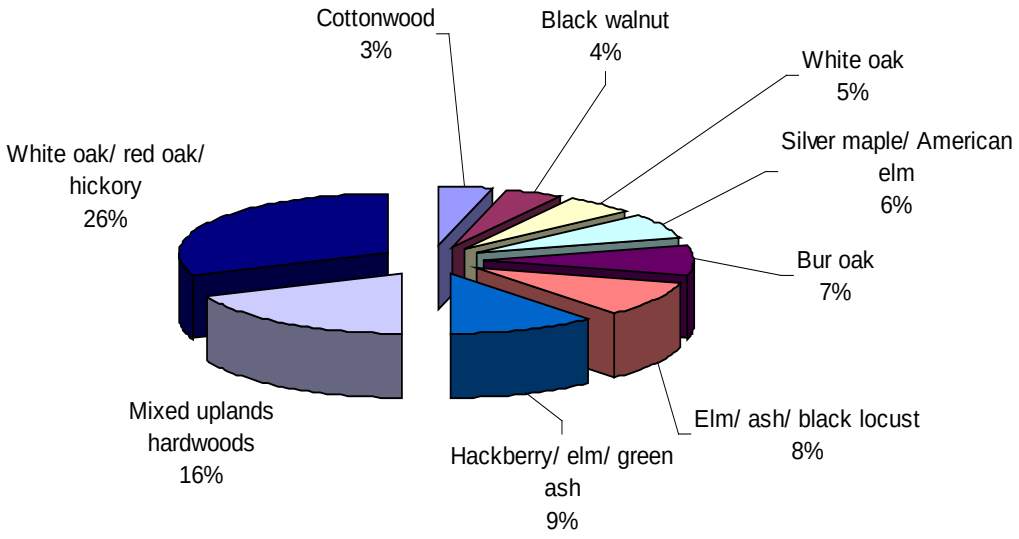
A mid-story sugar maple-basswood forest that has become established in place of an oak-hickory forest. Photo by Mark Vitosh.

Lack of oak regeneration is a concern across the state. Photo by Mark Vitosh.

Iowa forests contain over one billion trees from 68 species. Unfortunately, 25% of these trees are susceptible to fatal insect or disease problems such as oak wilt, oak decline, emerald ash borer, Dutch elm disease, and pine wilt. While most forests are relatively diverse, these threats will have a substantial impact on the composition of the state's forests and urban tree canopies in the future.

Figure 1.33 shows a breakdown of the major forest types in Iowa for 2008. The shade-intolerant white oak-red oak-hickory forest type represents the largest type of forest at 26%. The second most prevalent forest type is mixed upland hardwood, which accounts for 16% of the state's forests. At 4.5% of total forest land, shade-intolerant black walnut represents a small but economically important position in Iowa's forests.

Figure 1.33 Iowa Forest Types as a Percentage of Total Forest Land.



Source: Miles, P.D.

An ecosystem's forest type affects the wildlife habitat, herbaceous cover, wood products, recreational opportunities, and economic value of that ecosystem. Wildlife that depends on oak-hickory trees for habitat and food may not be able to survive without them; many of the common herbaceous plants found in oak-hickory stands cannot tolerate heavy shade; outdoor recreation enthusiasts looking for enjoyment from the wildlife and plants usually found in an oak-hickory forest may not receive the same level of satisfaction from shade-tolerant forests; and finally, without oak trees, the livelihood of sawmills that depend on a steady source of oak logs will be threatened.

Roughly 90% of Iowa's forests are privately owned, and Iowa DNR foresters work with approximately 2,000 forest landowners annually.

Duplication of pre-statehood forest conditions is impossible even as forests age. For example, the loss of elm trees to non-native diseases will forever change the nature of Iowa forest and community ecosystems. Increased human activity within and around natural ecosystems prevents these native ecosystems from maintaining and regenerating themselves like they had before Iowa was settled.

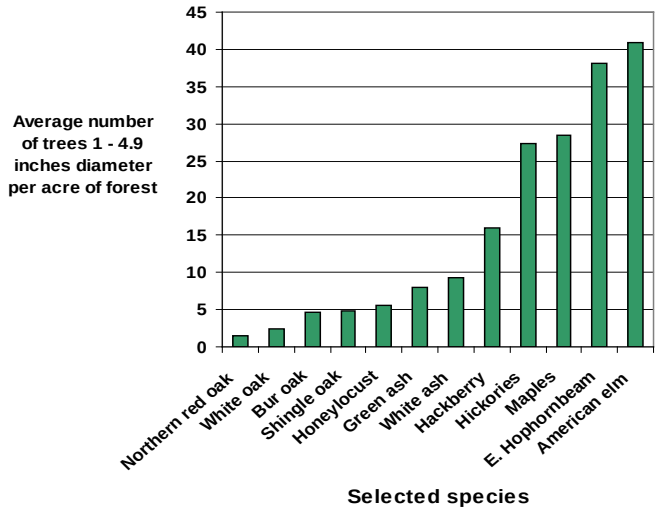
Roughly 90% of Iowa's forests are privately owned, and Iowa DNR foresters work with approximately 2,000 forest landowners annually. Interactions between foresters and landowners begin with evaluations of forest resources, discussions of forest landowner objectives, and consideration of forest management alternatives. Forest stewardship plans are then created to provide landowners a framework for achieving their management goals and objectives in sustainable ways. Meeting with private landowners gives professional foresters the opportunity to provide education about the benefits of proper long-term forest management. These interactions are especially important for landowners, who have limited forest ecosystem knowledge.

Species Types

Forest stands can contain a single species or a group of species with similar growth characteristics. A typical upland forest today contains large oak trees in the overstory with an understory dominated by shade-tolerant species. Oak is being out-competed by shade-tolerant species like sugar maple, basswood, bitternut hickory and eastern hophornbeam because these species are far more tolerant of shade than oak. Knowledge of forest plant communities is essential when making forest management decisions.

Many of Iowa's forests are dominated by mature timber. Figure 1.34 shows what tree species composition looks like below the dominant canopy layer. Shade-tolerant trees outnumber oak trees by an average of 6 to 1 in Iowa's forests. Without direct sunlight, current stands of oak will convert to the more numerous shade-tolerant species listed in Figure 1.34.

Figure 1.34 Average Number of Saplings per Acre of Forest Land by Species, 1999-2003.



Source: Leatherberry et al., 38.

According to Figure 1.35, eastern hophornbeam and shagbark hickory experienced the greatest decline in Iowa forests between 1990 and 2006; red mulberry, boxelder and hackberry experienced the greatest expansion during this time period. The significant increase in mulberry is a concern because it means that substantially more forest stand improvement work will be required in the future. Another species often selected for removal during forest stand improvement is eastern hophornbeam, second only to American elm in prevalence in 2006.

Figure 1.35 Species Changes in Iowa Forests, 1990 to 2006.

Species	Number of trees in 1990	Number of trees in 2006	Number of trees changed
Eastern hophornbeam	131,663,751	104,259,558	-27,404,193
Shagbark hickory	73,309,563	54,645,624	-18,663,939
Slippery elm	67,737,063	51,833,461	-15,903,602
White oak	41,734,022	25,866,363	15,867,659
Red oak	24,418,477	17,487,538	-6,930,939
American elm	168,992,484	162,961,260	-6,031,224
Black oak	14,378,840	9,756,449	-4,622,391
Green ash	25,870,879	23,297,021	-2,573,585
Basswood	50,110,623	49,196,025	-914,598
Butternut	1,387,109	766,888	-620,221
Red mulberry	19,541,469	48,432,540	28,891,044
Boxelder	37,234,047	63,212,686	25,978,639
Hackberry	47,359,666	62,451,393	15,091,727
Black walnut	19,604,048	34,378,639	14,774,591
Honey locust	13,493,588	26,752,296	13,258,708
White ash	17,783,056	29,600,187	11,817,131
Black cherry	30,887,957	41,122,421	10,234,464
Silver maple	45,579,708	52,471,135	6,891,427
Bur oak	27,326,085	32,971,049	5,644,964
Sugar maple	14,001,492	18,832,885	4,831,393
Bitternut hickory	36,902,962	41,236,334	4,333,373
Eastern redcedar	28,437,900	30,857,903	2,420,003

Source: Miles, P.D.

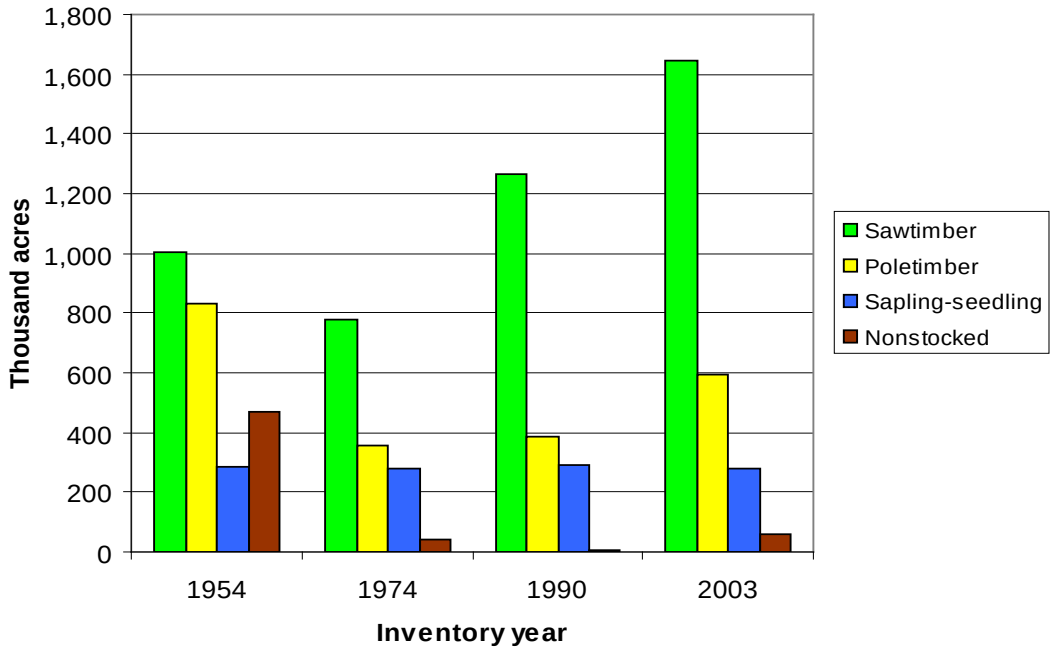
To put the data in Figure 1.35 into historical context, two types of forests, the oak-hickory and the elm-ash-cottonwood mix, made up 87% of the forest for Iowa in 1954.[17] Figure 1.35 shows that in 2008 they represented only about 57%. Changes in species groups that are inventoried together make it difficult for a direct comparison, but it goes without saying that there has been a huge change in the composition of Iowa's forests in the last fifty years. As was mentioned earlier, the effects of diseases such as Dutch elm disease and lack of disturbances like fire have contributed to this compositional change.

Size Class

Forests contain trees of various sizes. Stand size is a measure of the average diameter of the dominant trees in a stand; it is measured at 4.5 feet above the ground, expressed as diameter at breast height (DBH). Tracking changes in the distribution of stand-size class provides information about forest sustainability and succession, wood product material, wildlife habitat, and recreation potential.

Figure 1.36 shows that the number of acres of forest land made up of larger trees, known as sawtimber, increased by over 64% from 1954 to 2003. Sawtimber hardwoods are greater than 11 inches in DBH and sawtimber softwoods are greater than 9 inches in DBH. The expansion of areas made up of these large diameter trees indicates a maturing hardwood forest. The increasing area of sawtimber favors tree species that can regenerate under an existing canopy or shady conditions; oaks, hickory, and black walnut, on the other hand, require timber harvesting or other disturbances to regenerate successfully.

Figure 1.36 Long Term Comparison of Timber Land Area by Stand-size Class.



Source: Leatherberry et al., 23.

Figure 1.36 indicates that nonstocked areas, those containing less than 10% live trees, made up a larger area of Iowa's forests than sapling-seedling areas in 1954, likely because of the detrimental effects of Dutch elm disease or overharvesting. Nonstocked forest areas experienced major decline

[17]Thornton, P.L. and J.T. Morgan. The Forest Resources of Iowa. Forest Survey Release 22. Columbus, OH: U.S. Department of Agriculture – Forest Service, Central States Forest Experiment Station, 1959. p. 40.

from 1954 to 1990, nearly vanishing altogether, and then increased between 1990 and 2003, likely due to the effects of the major flooding that took place in the state in 1993; it will be interesting to see how the floods of 2008 affect these numbers in the coming years.

Lack of light and disturbances in maturing forests has kept the growth rate of saplings and seedlings relatively constant over the last 60 years; moreover, Iowa's maturing overstory has continued to grow in the sawtimber size class during this same time period, likely due to lack of disturbances and laissez-faire management practices on the part of forest landowners.

Figure 1.37 shows the number of acres of different forest types for small, medium, and large diameter size classes for 2008. According to this data, 66.7% of Iowa's forests were in the large diameter class, 19.9% were in the medium class, and 13.3% were in the small class.

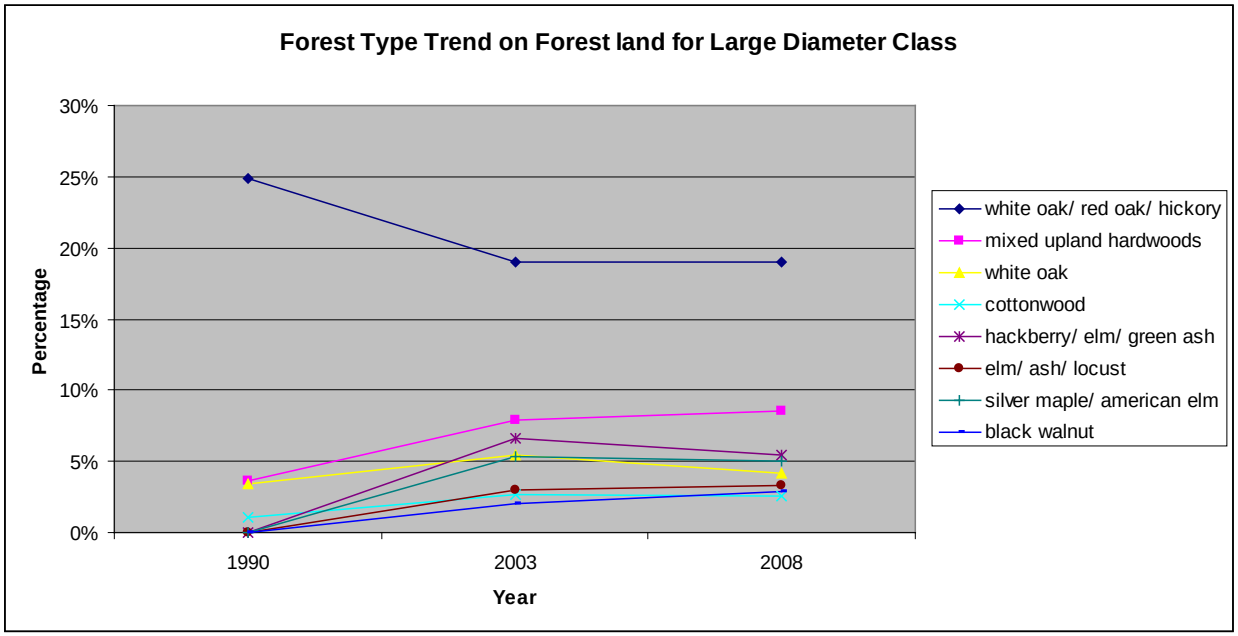
Figure 1.37 Breakdown of 12 Most Common Iowa Forest Types on Forest Land by Size, 2008.

Forest Type	Acres in Large Diameter (2008)	Acres in Medium Diameter (2008)	Acres in Small Diameter (2008)
Redcedar/Hardwood	21,438	26,835	13,154
Sugar Maple	24,590	0	0
Hard Maple/ Basswood	35,266	0	0
Cottonwood	76,253	8,337	17,789
Black Walnut	87,915	11,863	12,148
Elm/Ash/Locust	100,478	82,684	64,827
White Oak	127,414	8,069	0
Silver Maple/ American Elm	153,162	16,753	8,055
Hackberry/Elm/ Green Ash	163,949	163,949	34,550
Bur Oak	185,075	14,447	1,701
Mixed Upland	258,282	155,028	72,286
Hardwoods/White Oak	578,150	117,091	83,250
Red Oak/Hickory			
Totals	1,969,806	587,635	393,998

Source: Miles, P.D.

Figure 1.38 compares the composition of large diameter class forests in 1990, 2003, and 2008. Of the eight forest types shown, three have come to make up smaller percentages of total forest land over time: the hackberry-elm-green ash, silver maple-American elm and white oak-red oak-hickory types. The large diameter class made up 65% of Iowa's forests in 1990 and 2003, indicating that there was a modest increase from 2003 to 2008 and that Iowa's forests are therefore continuing to mature.

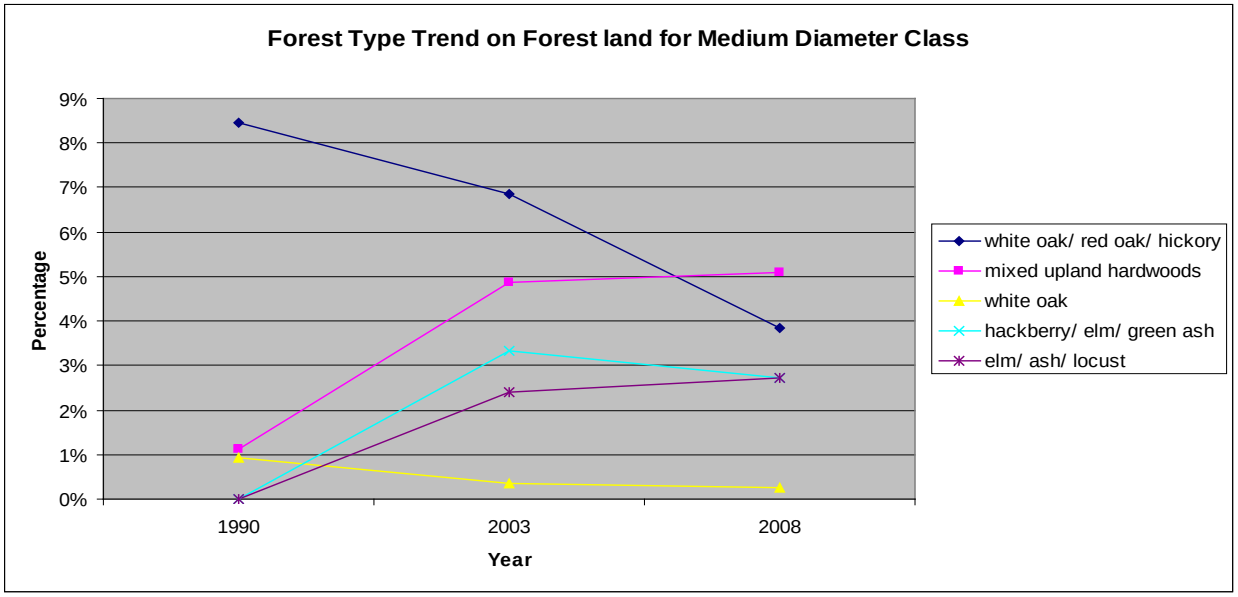
Figure 1.38 Forest Type Trends on Forest Land for Large Diameter Class.



Source: Miles, P.D.

Figure 1.39 shows the composition of the medium diameter class forests for the same years as in Figure 1.38. Of the five forest types in this figure, three have experienced decline: the hackberry-elm-green ash forest type between 2003 and 2008, and the white oak and white oak-red oak-hickory forest types between 1990 and 2008. These data indicate that there will be fewer white oaks, red oaks and hickories growing into the larger sawtimber size class in the future.

Figure 1.39 Forest Type Trends on Forest Land for Medium Diameter Class.



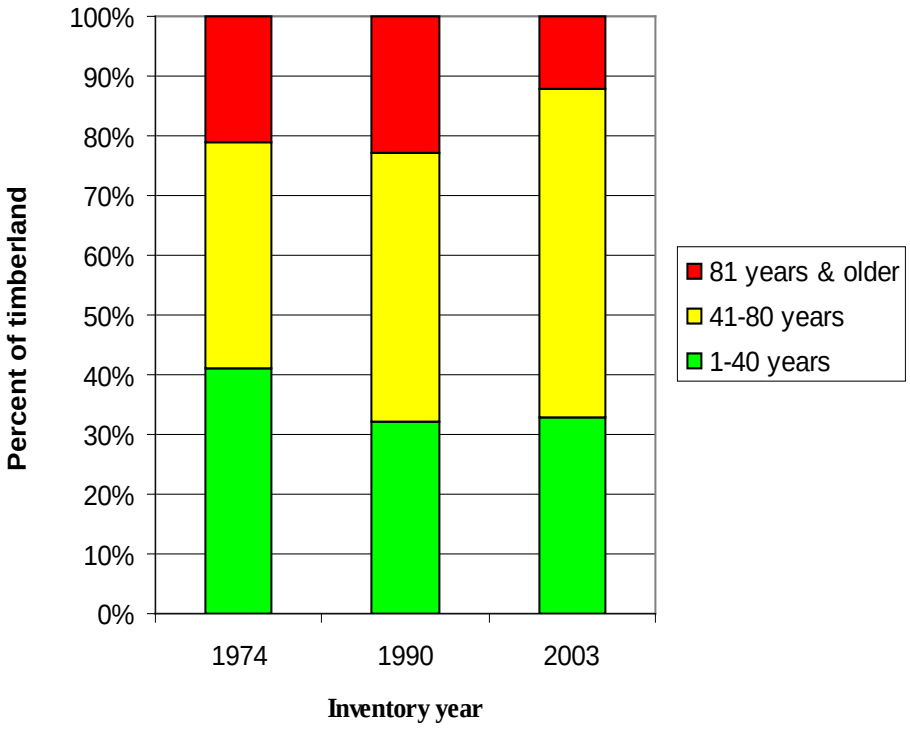
Source: Miles, P.D.

The only forest type experiencing decline in the small diameter class is white oak-red oak-hickory; there is no data for the white oak forest type, likely because the poor regenerative capabilities of this forest type in areas that lack direct sunlight and natural disturbances keep it from experiencing any kind of growth.

Age Class

According to Figure 1.40, timber land that is at least 81 years old came to make up a smaller percentage of total timber land in Iowa between 1990 and 2003; this change is attributable to an increase in shade-tolerant trees, which are no longer kept in check by fire. The percentage of land in the 41-81 year age class increased steadily over this time period, while land in the youngest age class experienced decline before 1990 and then leveled off afterward. In addition to variations in species and size classes, biologically diverse forests require age variability; Figure 1.40 shows that Iowa forests contain a good balance of young, middle aged and older trees.

Figure 1.40 Distribution of Iowa Timber Land by Stand Age Class, 1974-2003.



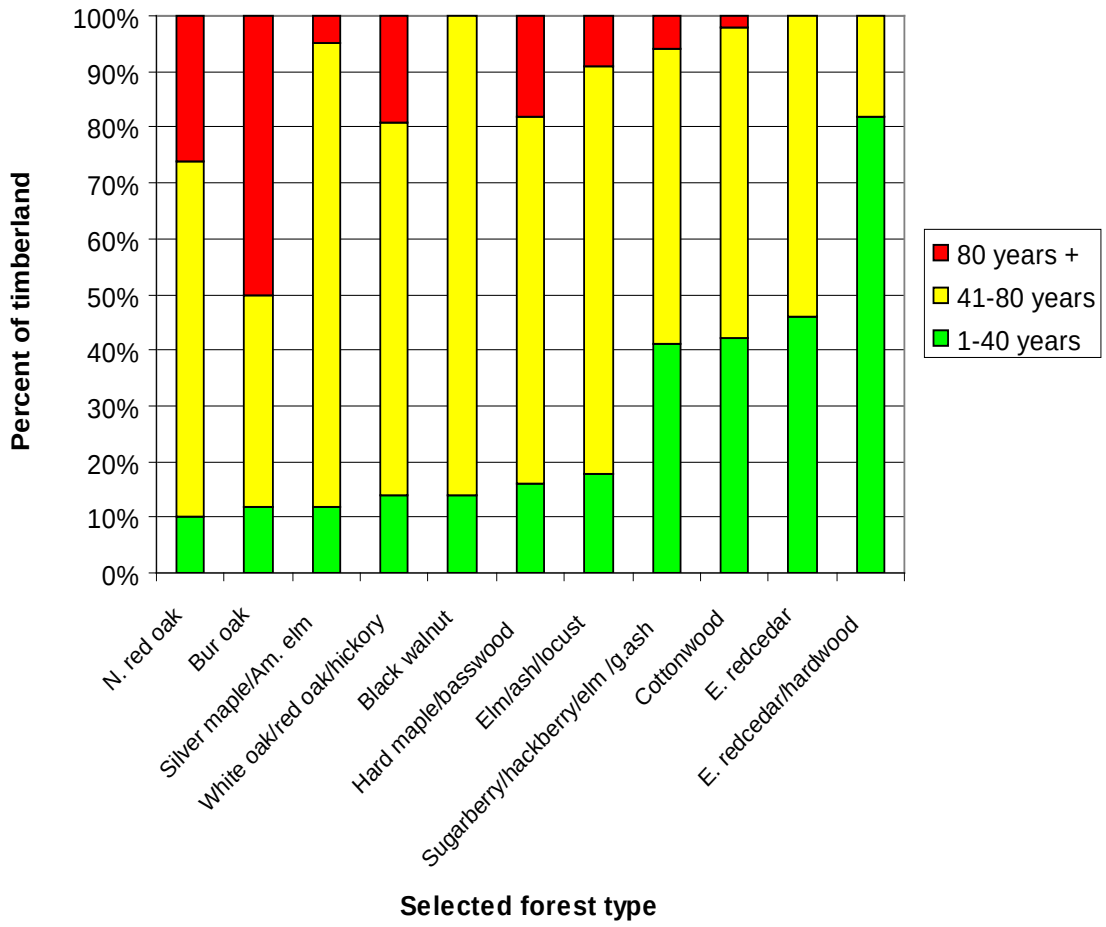
Source: Leatherberry et al., 25.

Successional Stage

In Iowa, late successional stage species include hard maple, basswood, and black cherry; mid-stage species include oaks, hickory, and black walnut; and early-stage species include hackberry, ash, cottonwood, locust, sycamore, river birch, silver maple, redcedar, and elm.

Figure 1.41 shows the age class composition of eleven forest types for 2003. Notice that roughly 50% of bur oak, 25% of red oak, and 20% of white oak-red oak-hickory were at least 80 years old. Another telling statistic is that all of the black walnuts in the state are younger than 80 years, undoubtedly a result of a disproportionately high demand for the species' use in timber products. Finally, early succession species like redcedar, cottonwood, green ash, elm, and hackberry are comprised of at least 90% middle and young age class trees.

Figure 1.41 Breakdown of Forest Type by Age Class, 2003.



Source: Leatherberry et al., 25.

1.3 Forest Land Conversion and Fragmentation

Fragmentation of Forests

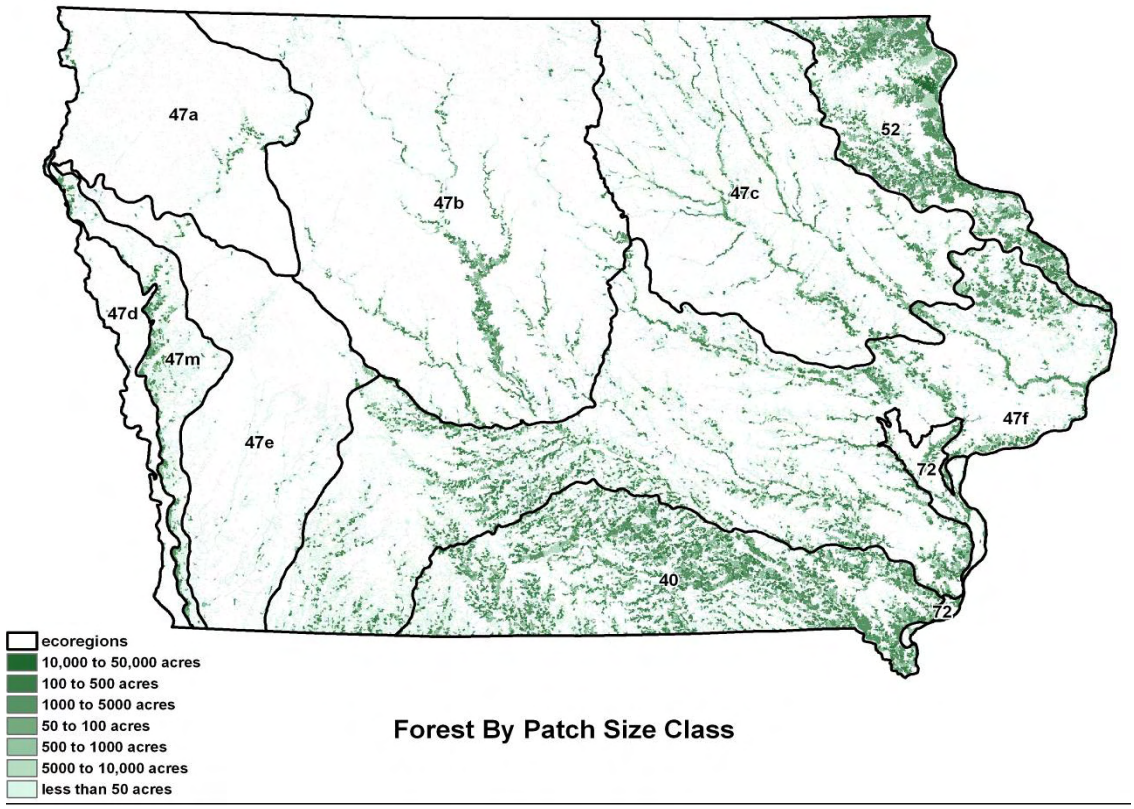
Breaking forest areas into smaller pieces affects habitat quality for many species of wildlife and understory plants, which in turn affects biological diversity; forest edge also increases, which makes it easier for edge wildlife species to find habitat than interior species and for invasive species to become established. As forested areas become developed, distance between patches increases, making it more difficult for wildlife and plants to move between these areas; when this happens, measures must be taken to ensure that species diversity, abundance, and breeding capabilities are maintained. Encouraging landowners to plant more trees is one solution to this problem, as it re-connects fragmented areas and in turn re-establishes travel corridors for wildlife (it is important to note that harvesting, which is the movement of forest to a different part of the successional timeline, it is not considered fragmentation).

Fragmentation has a huge impact on forest management decisions as well. For example, silvicultural treatments may be deemed impractical and therefore neglected on relatively small tracts of land. Harvesting small areas of forest is also less profitable for loggers because of the opportunity cost

of moving equipment from one area to another. Furthermore, landowners that lack knowledge of proper forest management often make decisions that cause more harm than good. One common result of such decisions is inadequate regeneration of desirable tree species, which will have a huge impact on future stand composition and overall forest cover quality.

Water quality is adversely impacted by fragmentation, mainly because of increased sedimentation. As impervious materials replace natural systems, water quantity also increases, leading to cutting and increased flooding. Finally, recreational opportunities decrease as a result of fragmentation, which has two significant environmental impacts: it increases travel distances for wildlife enthusiasts and thus leads to increased automobile emissions, and it puts undue strain on areas preserved for such activities, which can affect the long-term health of the species in these areas.

Figure 1.42 Contiguous Areas of Forest in Iowa.



Source: USDA-FS-NRS, Rachel Riemann.

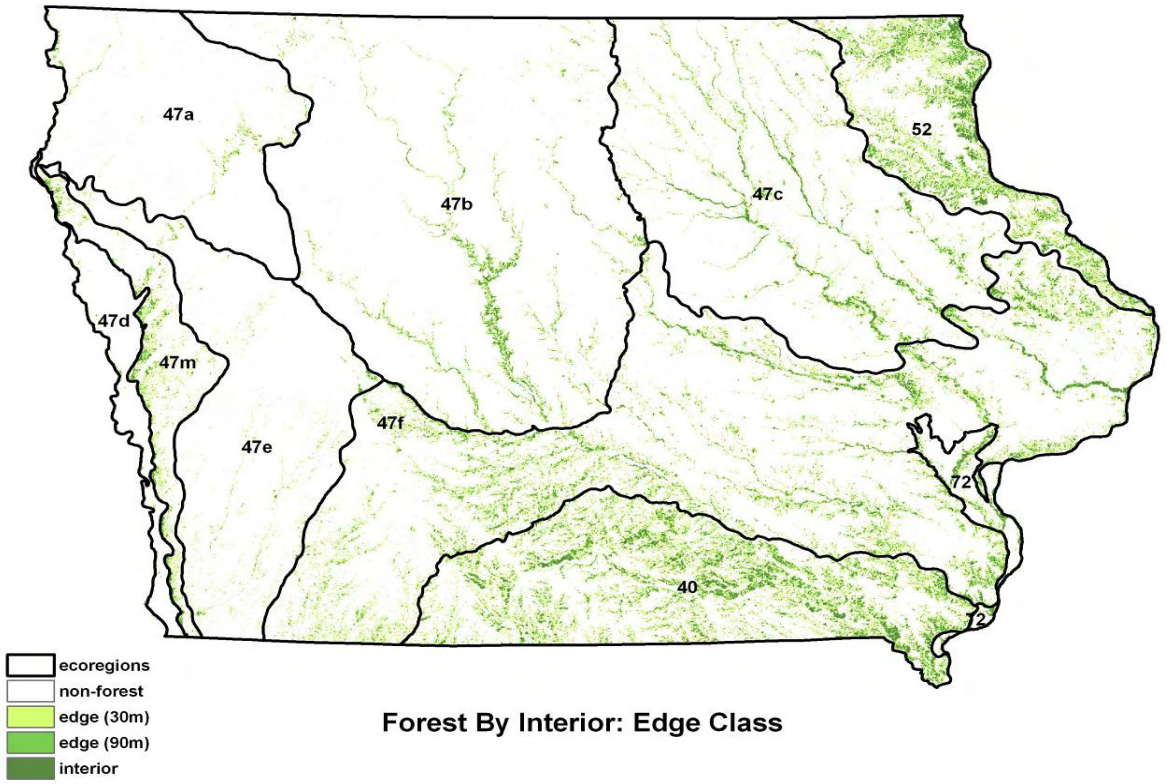
Figure 1.42 uses a color coding scheme to show where the largest areas of contiguous forest are in Iowa, with eco-region boundaries being separated by black lines (refer back to Figure 1.9 for eco-region definitions). Areas with contiguous forest, called patches, offer habitat for a variety of wildlife species. For this analysis, 100 acres is defined as the minimum patch size required for interior wildlife species. According to this figure, the Central Irregular Plains, Paleozoic Plateau, and Southern Iowa Rolling Loess Prairies eco-regions have the most areas of forest patches greater than 100 acres. The table in Figure 1.43 shows the number of forest acres in patches of 100 acres or less juxtaposed with the number of forest acres in patches greater than 100 acres for each of the state's eco-regions.

Figure 1.43 Acres of Forest based on 100 Acre Patch Size by Eco-region.

Eco-region	Portion of Forest in Patches < = 100 Acres	Acres of Forest < = 100 Acres	Acres of Forest > 100 Acres
Central Irregular Plains	35%	242,600	450,600
Paleozoic Plateau	21%	100,900	379,600
Southern Iowa Rolling Loess Prairie	57%	494,200	372,800
Iowan Surface	52%	144,400	133,200
Des Moines Lobe	46%	101,000	118,800
Loess Hills	54%	72,200	61,400
Interior River Lowlands	40%	17,400	26,300
NW IA Loess Prairie	72%	28,900	11,200
Loess Hills Rolling Prairies	91%	66,900	6,700
Missouri Alluvial Plain	61%	9,600	6,100
Total	45%	1,278,100	1,566,700

Source: USDA-FS-NRS, Rachel Riemann.

Figure 1.44 Iowa Forest by Interior: Edge Class.



Source: USDA-FS-NRS, Rachel Riemann.

Another way to evaluate the suitability of Iowa's forests for interior wildlife and plants is to define how much area in the core or middle of the forest there is in relation to buffered forest edge; interior areas are less accessible for invasive species and other threats, and are therefore more likely to maintain their biological integrity. Figure 1.44 and the table in Figure 1.45 show where there is forest land with enough core area to sustain interior species populations. Edge forests are defined here as forest areas for which the distance from the center to any outside edge is less than 300 feet; forests for which this distance is greater than 300 feet are defined as interior or core forests. These data can help to highlight areas of the state that are in need of tree plantings to increase forest connectivity and reduce forest edge.

According to the above definition, 772,500 acres of Iowa forest are classified as interior; the eco-regions with the greatest amount of interior forest are the Central Irregular Plains, Southern Iowa Rolling Loess Prairie, and the Paleozoic Plateau, the same regions with the greatest number of 100+ acre forest patches. While some regions have very little interior forest, it is important to note that every region contains some interior forest; however, regions with relatively small amounts of interior forest do not possess the wildlife diversity of regions with relatively large amounts.

Figure 1.45 Interior Forest and Edge by Eco-region.

Eco-region	Proportion of Forest that is Interior	Acres of Forest Interior	Acres of Forest Edge
Central Irregular Plains	29%	201,000	492,200
Southern Iowa Rolling Loess Prairie	22%	190,000	676,300
Paleozoic Plateau	32%	153,800	326,700
Iowan Surface	30%	83,300	194,900
Des Moines Lobe	25%	54,900	164,900
Loess Hills	43%	45,400	88,200
Interior River Lowlands	60%	26,200	17,500
Missouri Alluvial Plain	44%	6,900	8,800
Loess Hills Rolling Prairies	8%	5,900	67.700
Northwest Iowa Loess Prairie	11%	4,400	35,700
Totals	27%	772,500	2,072,300

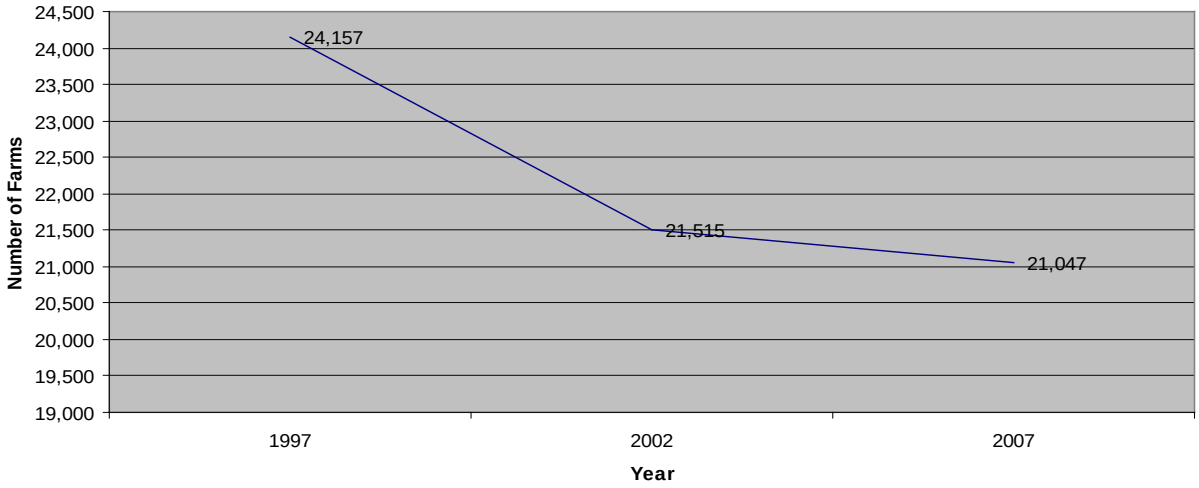
Source: USDA-FS-NRS, Rachel Riemann.

Ownership

Understanding forest resource ownership in Iowa requires consideration of how the state has grown and evolved since the time it was settled. In 1954, Iowa contained approximately 193,000 farms at an average size of 176 acres; by 2007, the number of farms had been cut by more than half to 92,600, with the average size nearly doubling to 331 acres.[18] The number of farms owned by families or individuals fell from over 100,000 in 1974 to 77,452 in 2007; conversely, the number of farms owned by corporations doubled from 1974 to 2007.[19]

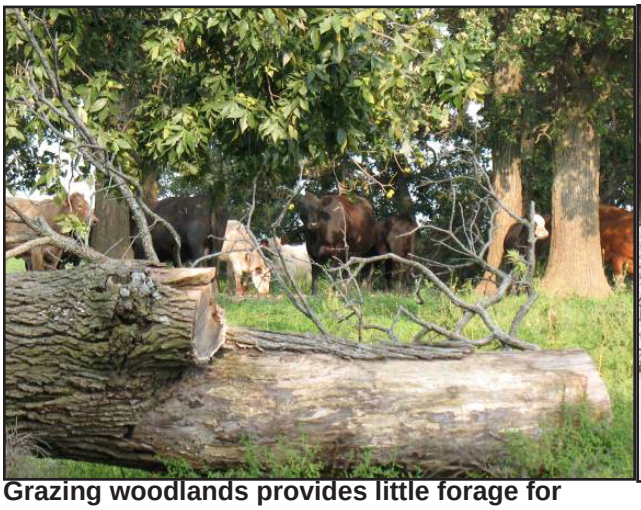
As size and ownership of Iowa farms have changed, so have trends related to forest land on farms; Figure 1.46 shows that in recent years, there has been a decline in the number of farms with woodland, from over 24,000 in 1997 to 21,000 in 2007.[20]

Figure 1.46 Number of Iowa Farms with Woodland, 1997, 2002, and 2007.



Source: USDA-Farm Service Agency.

The pictures below shows a degraded root system from a tree growing in grazed woodland. Grazing not only prevents young trees from growing, but adversely affects the stocking and quality of



Grazing woodlands provides little forage for livestock and reduces timber value. Photo by Mark Vitosh.

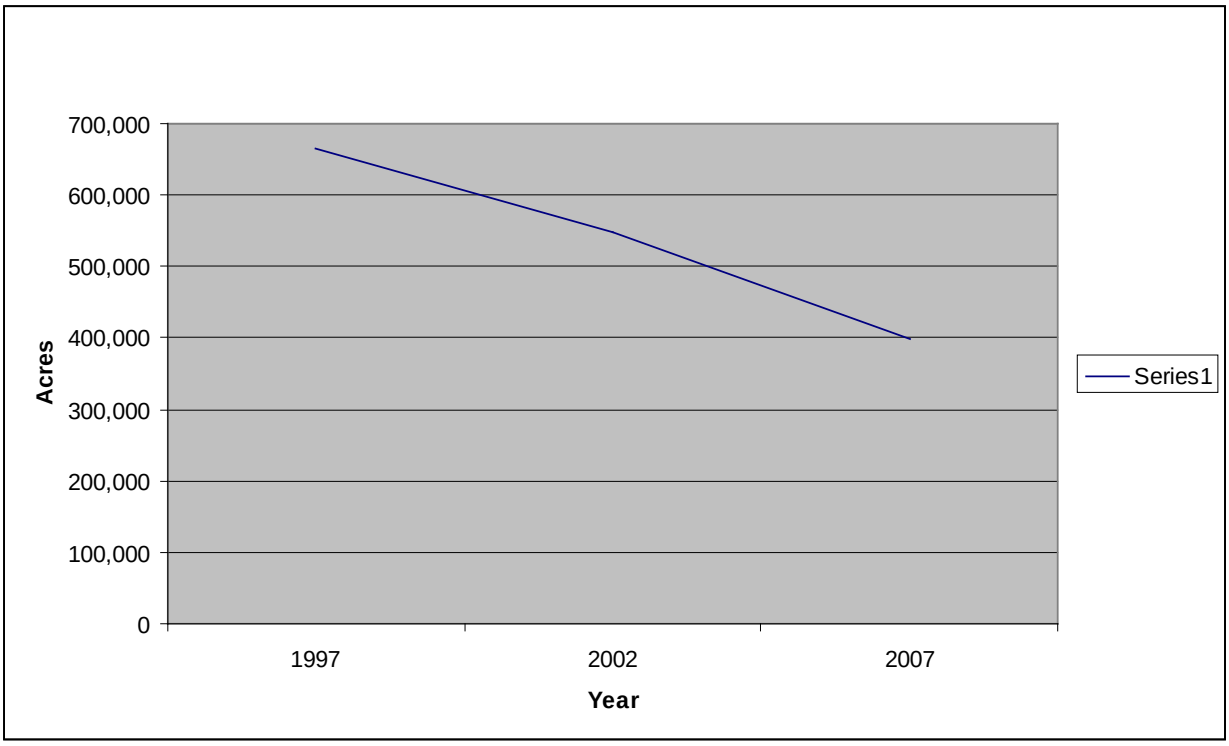
Decayed root system. Photo by Mark Vitosh.

[18]<www.nass.usda.gov/Statistics_by_Subject/Demographics/index.asp>. February 18 2010.
[19]<www.ers.usda.gov/statefacts/ia.htm#FC>. February 20 2010.
[20]<www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/Iowa/st19_1_008_008.pdf>. February 1 2010.

trees, as browsing, soil compaction, and rubbing from livestock take their toll on the forests. The losses in tree growth from overgrazing of woodlands cannot be measured, but the damage done will take years to reverse. Fortunately, as Figure 1.47 indicates, the number of acres of woodlands grazed have been decreasing in recent years, from 664,000 acres in 1997 to 399,000 acres in 2007. Interestingly, forest land that was once neglected by forest inventories because of grazing is now taken into consideration, which is one explanation for the increase in total forest land in recent years.

Removing livestock from woodlands is the first step to restoring the ecosystem that once provided habitat to a wide variety of wildlife and herbaceous plants. The next step is to inform forest landowners to work toward increasing the productivity, biodiversity and overall health of these woodlands for future generations. Too often, landowners believe that a laissez-faire approach to woodland management is the best approach – little do they realize, for example, that the increasing presence of invasive species and the inability of oak seedlings to survive are reasons that sound advice from knowledgeable foresters and hands-on management are crucial for the health and longevity of their forests.

Figure 1.47 Number of Acres of Woodlands used for Grazing, 1997, 2002, 2007.



Source: USDA-Farm Service Agency.

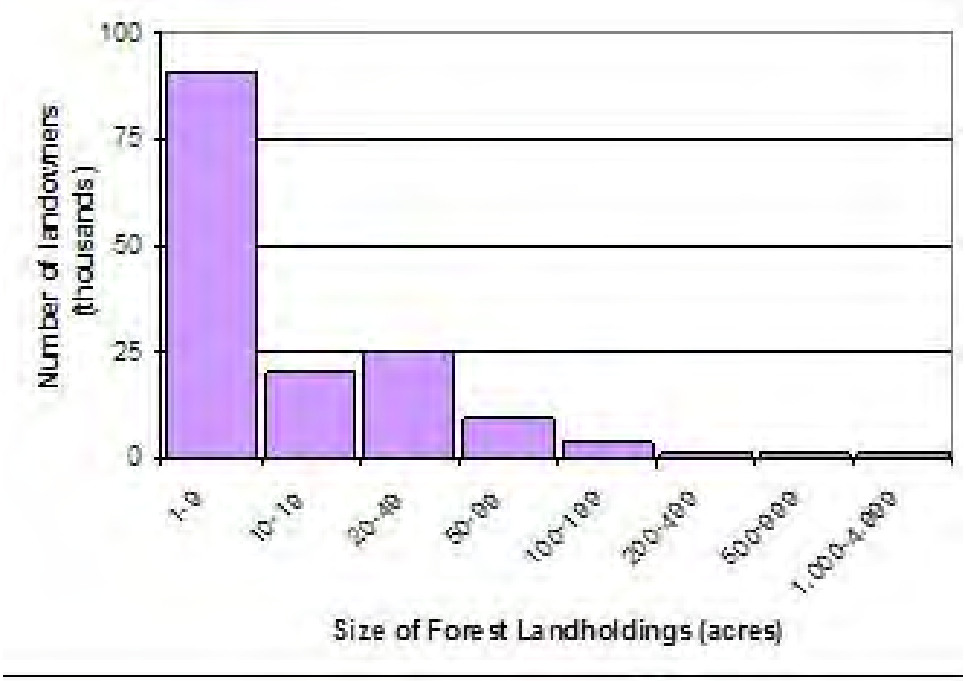
Privately-owned woodlands have decreased dramatically in size since the middle of the 20th century. In 1954, the average woodland owner owned 45 acres of woodland; this number shrank to 31 acres in 1990 and 17 acres in 2003. Figure 1.48 shows that in 2006, the majority of forest landholdings were less than nine acres; moreover, the number of private woodland landholdings nearly tripled from 55,000 in 1990 to 150,000 in 2008.[21] These numbers are

The number of private woodland landholdings nearly tripled from 55,000 in 1990 to 150,000 in 2008.

[21]Butler, Bret J. 2008. Family Forest Owners of the United States, 2006. Gen.Tech. Rep. NRS-27. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. p 72.

alarming because they reflect the extent to which interior forests have been reduced over time and the extent to which they may be reduced in the future. With this in mind, it is crucial that steps be taken at both the public and private level to ensure that the fragmentation of Iowa's forest cover is minimized, and that small landholdings are managed as best as possible. Though cost share opportunities are available, it is often difficult for small woodland owners and woodland owners without cropland to qualify for these programs.

Figure 1.48 Forest Landownership by Size of Forest Landholding, 2006.



Source:Nelson and Brewer.

Figure 1.49 Breakdown of Forest Land by Ownership.

Year	Total Forest	Fish and Wildlife Service	Dept. of Defense & Energy	Other Federal	State	County/ City	Private
1990	1,947,937	N/A	N/A	43,907	74,445	37,631	1,663,489
2003	2,578,669	20,605	12,369	54,969	145,522	32,044	2,313,160
2004	2,687,101	23,282	20,612	55,750	154,874	44,241	2,388,343
2005	2,823,705	24,628	35,493	44,272	156,761	51,127	2,511,424
2006	2,939,615	26,809	53,079	33,470	192,849	77,033	2,556,376

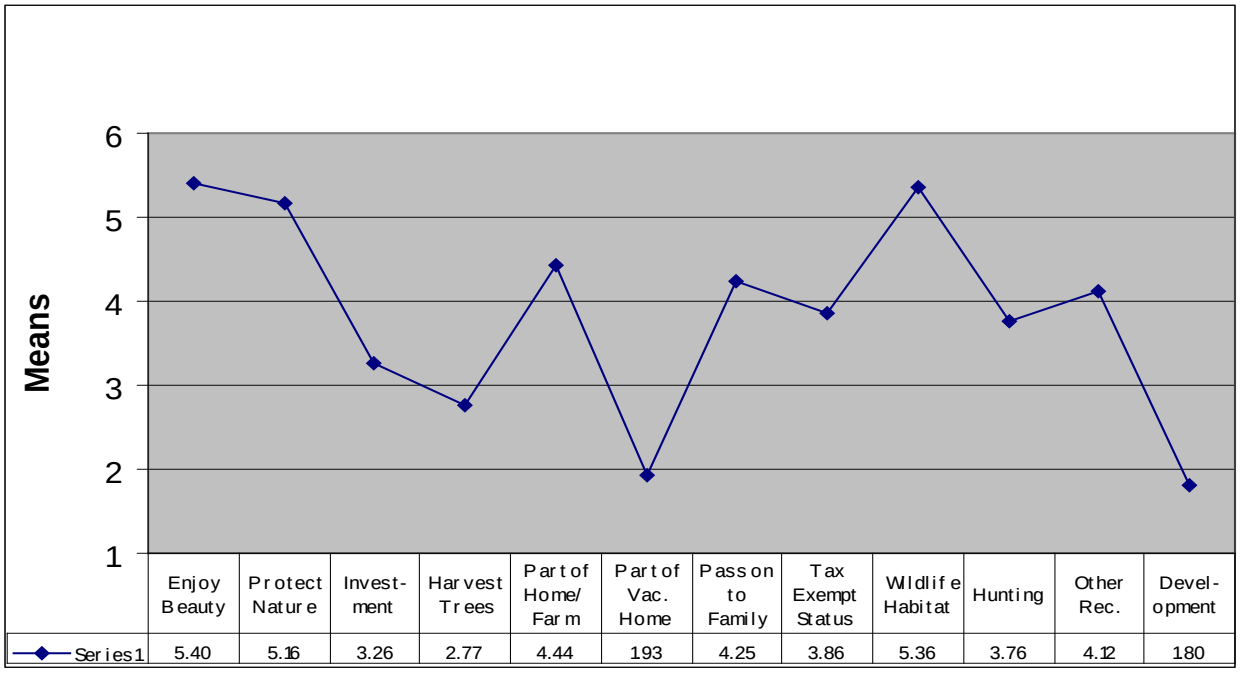
Source: Miles, P.D.

According to Figure 1.49, the overwhelming majority of forest land in the state has been held by private landowners for at least the last twenty years; state agencies are in a distant second for overall landownership, followed by counties and federal agencies. There are a number of reasons that people choose to own forested land, the most common among them being scenery, protection of nature and biological diversity, privacy, farmland complementing, and heredity.

Figure 1.50 shows the results of a 2002 survey of 968 Iowa forest landowners that gives the reasons for forest or woodland ownership. The most commonly-sited reasons are enjoyment of

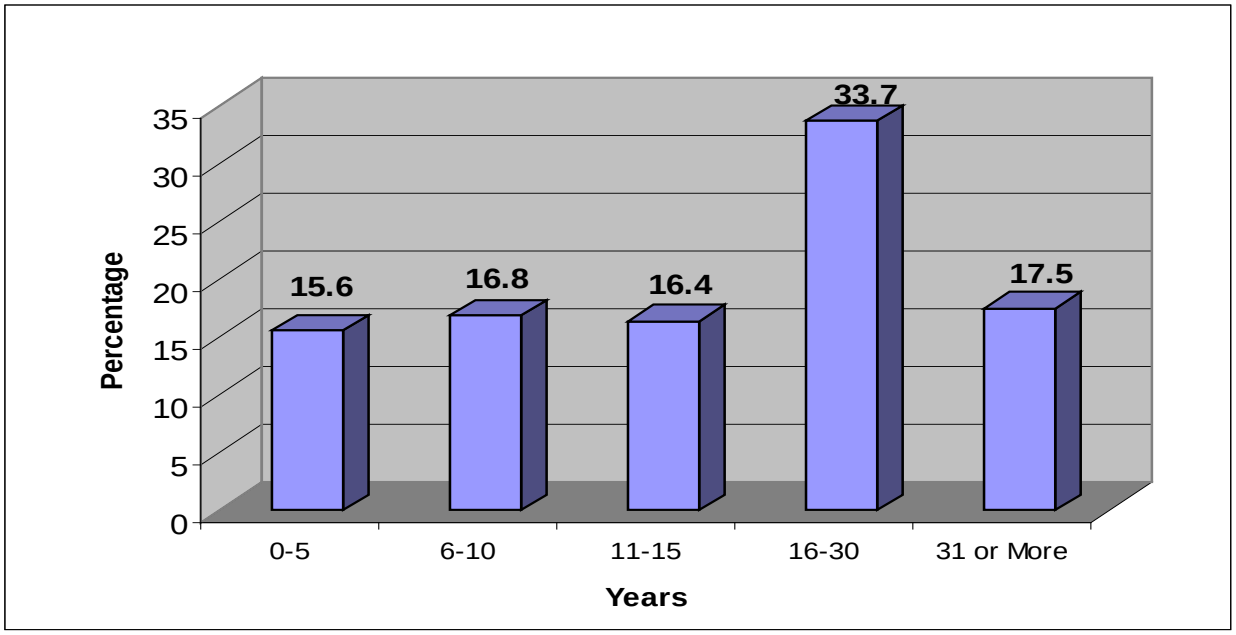
beauty and scenery, protection of nature and biological diversity, farm or home additions, privacy and posterity. According to the same survey, roughly half of respondents acquired their first Iowa woodland parcel at least 16 years prior, with 17.5% having obtained at least one parcel of woodland more than 30 years prior.[22] A complete breakdown of woodland ownership by length of time is given in Figure 1.51. A high turnover rate for landownership can be detrimental for the long-term management needed in order for a forest to maintain multiple productive uses.

Figure 1.50 Reasons for Private Woodland Ownership in Iowa, 2002.



Source: Iowa Forest Reserve Program Study: Aggregate Results Task 1.

Figure 1.51 Length of Time of Private Woodland Ownership in Iowa, 2002.



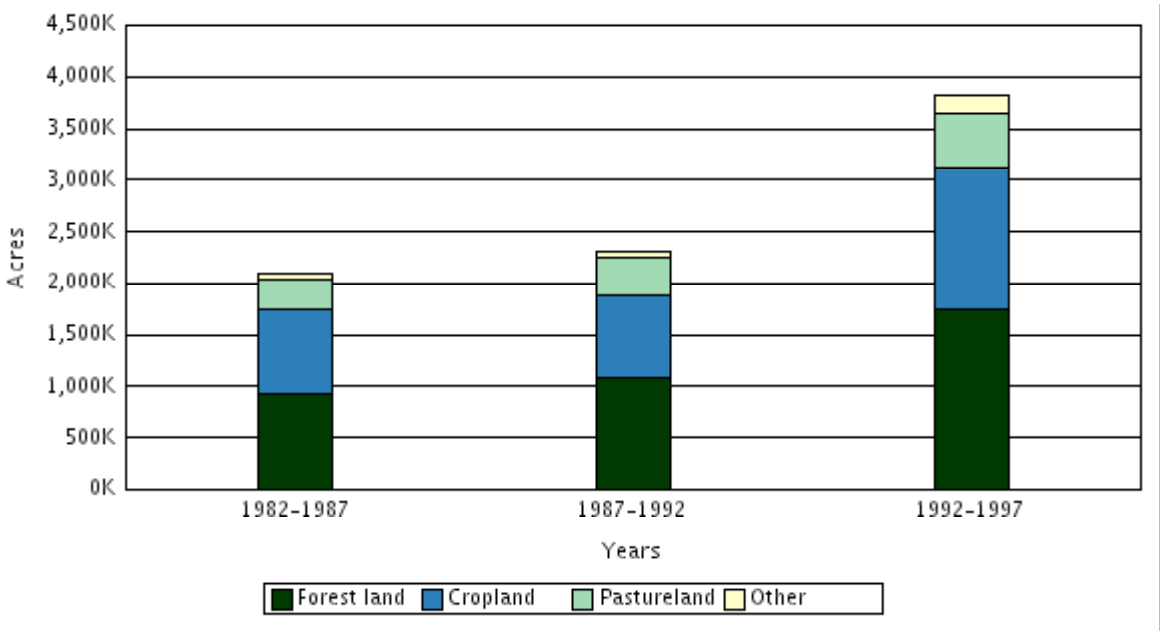
Source: Iowa Forest Reserve Program Study: Aggregate Results Task 1.

[22]"Iowa Forest Reserve Program Study: Aggregate Results Task 1." <www.iowadnr.gov/forestry/pdf/Consumerdatareport.pdf>. March 9 2009.

Forest Land Development

As was mentioned earlier in this assessment, Iowa annually lost an average of 18,000 acres of forest land to development between 1992 and 2002. As Figure 1.52 demonstrates, the amount of forest, cropland, or pasture developed annually in the northern United States nearly doubled from 1982 to 1997, and of these three land cover types, forests have experienced the most development.

Figure 1.52 Amount of Land Developed by Land Cover Type in the Northern United States, 1982-1997.

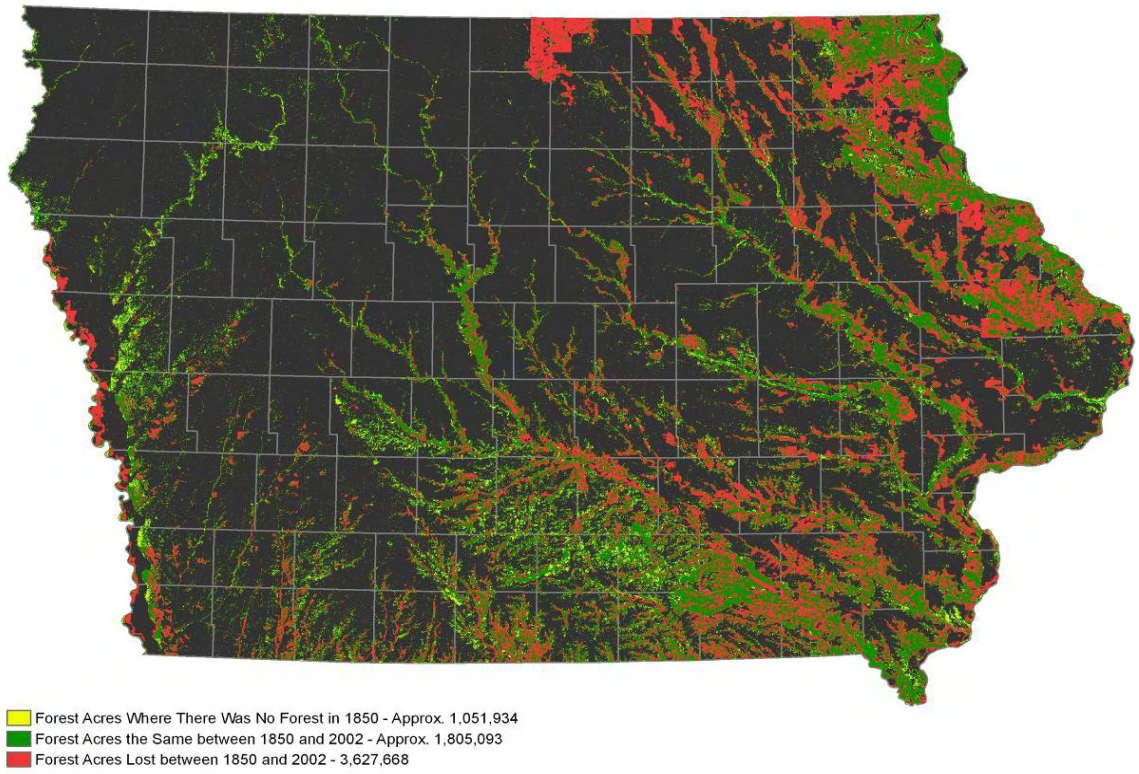


Source: U.S. Department of Agriculture, Forest Service - Forest Sustainability Indicators Information System. [Database].

Net Change in Forest Land

Since 1850, 1,051,934 acres of forests have emerged in what are considered to be new locations; another 1,794,958 acres of forest that existed prior to 1850 are still around today. Iowa had approximately 6,471,581 acres of forest area in 1850, which means that 4,676,623 acres of original forest have been removed since this time. Since only 1,051,934 acres have been restored since then, Iowa has experienced a net loss of 3,624,689 acres of forest, or more than half of the forest area in existence at the time of European settlement. No data exists to describe if the best quality forest was lost or what the remaining composition of the original forests that were not lost are. Though details about the amount of forest lost within each eco-region were given in Figure 1.9., there is no way to determine the quality, composition, and other characteristics of these lost forests. Much of the forest that was removed came from land with relatively high quality soil, and for the purpose of crop production. The red in Figure 1.53 shows where most of Iowa's forest resource has been lost since 1850.

Figure 1.53 Forest Land Change, 1850 and 2002.



Source: Kathryne Clark using General Land Office (GLO) Maps as Surveyed from 1836-59, Iowa cooperative soil survey and Iowa DNR geological survey.

Native Seedlings

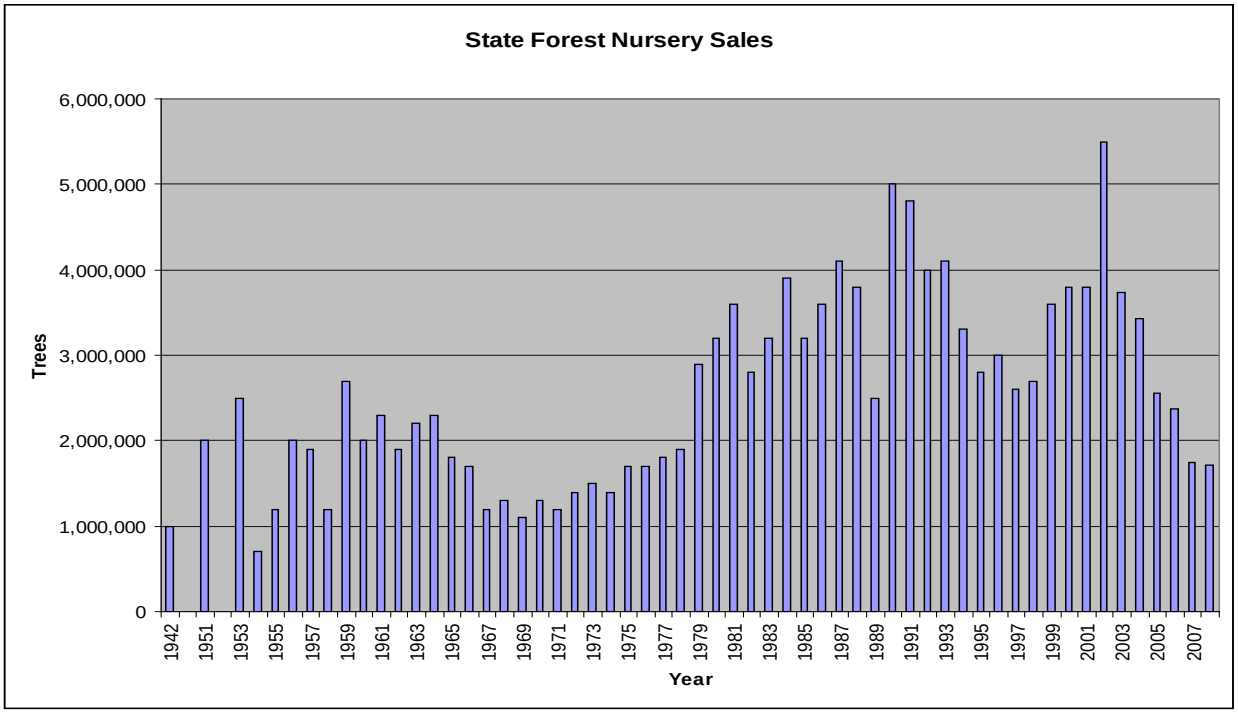
Native conservation seedlings from the State Forest Nursery planted on private land. Photo by Bruce Blair.

Since Iowa officially became a state, people have been planting trees for shelter, fuel, protection from the elements, and a host of other reasons. The establishment of the State Forest Nursery in the 1930's helped to supply low cost, native bare root tree and shrub seedlings for conservation plantings on public and private lands. Providing native genetic material to landowners helps to maintain genetic diversity, allowing all tree species a better chance to survive climatic changes and potential insect and disease problems. The nursery has sold more than 150 million seedlings since its establishment, including 64.5 million in the last twenty years alone. This relatively high volume of sales in recent years has led to the establishment of more than 15,000 new acres of forest in the state, and is due in large part to the effects of various conservation programs.

Private landowners have responded positively to market incentives and government programs, including subsidized afforestation on unproductive agricultural land, which is one reason that forest

land has increased in the state in recent years. The ability of the State Forest Nursery to supply large quantities of native nursery stock at a relatively low cost has provided Iowans with excellent opportunities to develop forests on their land; without the nursery, Iowans would have had to pay more for their seedlings, which would have left them with fewer resources for weed control and other activities critical for successful tree planting establishment; had this happened, it is likely that fewer acres would have been planted during this time period. It is important that promotions of tree planting continues to ensure that landowners stay in touch with their properties and leave legacies for future generations; this is especially important when considering the extent to which landholdings have shrunk in the last half-century.

Figure 1.54 History of Iowa State Forest Nursery Seedling Sales.



Source: State Forest Nursery Manager, Roger Jacob.

Tree Planting

Figure 1.55 shows that the amount of land enrolled for conservation practices by the National Resource Conservation Service (NRCS) increased between 2002 and 2004; however, there was also a decrease in the number of acres of trees actually planted over the same time period. Tree planting represented only slightly more than 1% of the conservation acres funded by the NRCS; the permanent establishment of woody vegetation is something most farmers steer away from, as grassland is much easier to establish, maintain, and, if so desired, reconvert to agricultural land.

Figure 1.55 Base Conservation by NRCS in Iowa, 2002 to 2004.

	2004	2003	2004
Acres planned for conservation	1,440,157	1,153,154	1,174,262
Acres of trees planted	3,518	4,398	6,399
Highly erodible land treated (ac)		381,708	405,678

Source: www.ia.nrcs.usda.gov/programs/conservationoperations.html.

Since 2003, the number of planted forest acres has risen by 11% to 63 million acres, and growing stock volume on planted forests has risen by 32%; this is an indication that intensive management and superior seedlings are having a big impact when applied toward reforestation.

Preserving Tree Genetics

Black walnut tree selected for its superior genetic qualities. Photo by Jeremy Cochran.

Black walnut is Iowa's most valuable timber species. Photo by Paul Tauke.

The goal of Iowa's tree improvement program is to preserve the genes of locally adapted trees. Currently, the program is focused on the development of high-value black walnut trees for timber products and the preservation of butternut trees under threat of extinction from canker. If the program were to receive additional funding, other species in need of special consideration could be added. Maintaining a pool of genetic diversity for all native species on sites located across the state would ensure that Iowa's trees are in a suitable position to withstand climate change and threats from disease and insects in the future; this would also provide a dedicated seed source to supply future seed needs for nurseries to ensure a native local seed source is available.

The tree improvement program has collected from a diverse gene pool of black walnut trees in Iowa. As the most valuable black walnut trees are harvested, branches are collected in order to propagate seedlings with identical genetics. This will give landowners a better pool of trees from which to choose for growing, and will have positive implications for future yield and genetic and biological diversity; once enough of these trees are selected, there will also be a large enough sample of genes to represent over 95% of the genetic variation within this species. Since 2003, the program has been testing for a fast growing black walnut tree capable of growing above vegetation and wildlife browsing lines to quickly capture a site. The most successful tree so far, which is being reproduced and tested in field trials to see how it performs under various growing conditions, experienced growth of almost 9 feet in 2 years and 25 feet in 5 years.

The other current focus of the tree improvement program is to preserve the genes of the valuable native butternut in an effort to prevent its extinction from butternut canker. Branches are collected from native trees and then grafted onto walnut root stock in an effort to maintain a population of native Iowa butternuts. Seedlings from twenty Iowa trees and over 100 trees from other states are being tested at the Loess Hills State Forest in western Iowa and Yellow River State Forest in northeast Iowa (the latter site is in an area of the state that is still highly susceptible to the disease, while the former site is outside of the butternut canker range).

Butternut seedlings established at Loess Hills State Forest. Photo by Aron Flickinger.

1.4 Status of Forest Communities and Wildlife Species of Special Concern

Baby Opossums. Photo by Bruce Ehresman.

There are two primary aspects of wildlife habitat: food and shelter. Many creatures rely on trees for habitat, and the usefulness of a tree or group of trees depends on factors such as size, condition and spacing. Generally speaking, a tree's value to wildlife is proportional to its size, since trees that are relatively large are able to provide more food and more opportunities for shelter than trees that are relatively small. Trees that produce fine hardwood products are usually valuable for wildlife because they produce acorns and nuts (known as mast); as these trees age, they may also develop cavities that birds and animals can use for shelter. Other tree species of value to wildlife include aspen (buds used for food), silver maple (mostly shelter), serviceberry (food and shelter), pines (shelter and roosting sites), red cedar (food and shelter) hawthorn (shelter) and crabapple (food). A large variety of shrubs such as wild plum, ninebark, dogwood, hazelnut, elderberry, arrow wood, nannyberry and common choke cherry can also provide food and shelter for wildlife.

Historically speaking, most of Iowa's forests have existed along river corridors; these areas have shrunken in size as a result of agricultural growth, which has had a huge impact on water quality and habitat availability. Forested river corridors are important to terrestrial and aquatic wildlife because they provide connectivity to larger tracts of forest and shade water from hot sun rays in the summer.

The remaining pieces of the state's original landscape can and do attract wildlife, but small habitat remnants obviously cannot sustain the array of birds and animals that once lived in Iowa. Forest wildlife such as red-shouldered hawks, long-eared owls, cerulean warblers, Indiana bats, timber rattlesnakes, and southern flying squirrels used to be common inhabitants of Iowa's woodlands, but are now in decline due to loss and fragmentation of suitable habitat.

Conservationists have been able to help a small number of species recover from habitat loss. Peregrine falcons, wiped out by the pesticide DDT in the 1960's, are nesting again with the help of captive breeding; wild turkeys, bald eagles, river otters and trumpeter swans have rebounded as well. Wildlife conservation funding is limited, however, particularly for non-game species, so the future of many of Iowa's forest species is not secure.

About 150 Iowa plant species have been classified as rare or endangered, while 40 more have not been seen for decades. To avoid losing more species, Iowans must learn how to maintain their habitat into the future. For county-level maps showing threatened and endangered species status and distribution, visit the Natural Areas Inventory website at https://programs.iowadnr.gov/naturalareasinventory/pages/Query.aspx

The fragmentation of Iowa's remaining forest resources makes them even more susceptible to invasive species. With few natural enemies, exotics disrupt native communities in a number of different ways: exotic bush honeysuckles and buckthorn take over the understory layer of forests, choking out native species; oriental bittersweet aggressively edges out other woodland species by girdling trees or shading out understory vegetation; garlic mustard poses a severe threat to woodland wildflowers, out-competing native species for light, space, water and nutrients. Aside from their devastating affects on native trees and plants, these invasives provide relatively little for native wildlife creatures, and so threaten their existence as well.

Successful natural reproduction of native wildlife populations is dependant upon habitat protection; clean water and air and protection from predators are necessary for the long term health of wildlife. Unfortunately, society continues to struggle to find a balance between economic development and the long-term sustainability of natural communities.

Iowa's woodlands benefit a variety of wildlife, including birds, mammals, reptiles, amphibians, butterflies and snails. Water corridors that meander under tree canopies have less extreme temperature fluctuations than those that don't, and therefore provide superior habitat for many aquatic species as well. Although Iowa cannot and will not sustain the breadth of wildlife species that used to inhabit the state's natural areas, Iowans are still fascinated with the wildlife that still exists in the state; for example, the U.S. Fish & Wildlife Service estimates that more than a million of Iowa's 3 million citizens watch, hunt, or fish for wildlife.

Forest-associated Communities and All Wildlife Species

According to the Iowa Wildlife Action Plan (IWAP), conservation activities should be directed to regions of the state having the greatest wildlife species diversity.[23] The Iowa Gap Analysis Program (GAP) is a model for predicting the degree to which native animal species and natural communities are represented in the present-day mix of conservation lands. Those species and communities not adequately represented in the existing network of conservation lands constitute conservation "gaps." The purpose of Iowa GAP is to provide broad geographic information on the status of ordinary species (those that are not threatened with extinction or are naturally rare) and their habitats in order to provide land managers, planners, scientists and policy makers the information they need to make better-informed decisions.[24]

Maps that delineate regions of the state with the greatest potential terrestrial vertebrate wildlife diversity based on habitat distributions (Figure 1.57) are produced using this information. Hexagons shown on the species richness maps cover 635 square kilometers; Iowa has a total of 265 of these units either wholly or partially within the boundaries of the state.

Iowa lacks comprehensive distribution data for many terrestrial and aquatic species; because of this, the Multi-Species Inventory and Monitoring Project (MSIM) was launched in 2006 to conduct a statewide inventory of Iowa's fish and wildlife resources. Once the inventory phase is complete, the project will allow scientists to monitor changes in species distributions over time.

A table of all wildlife species known to inhabit forested areas in Iowa is included in Appendix F. For species of greatest conservation need (SGCN), promoting woodland management activities

[23]Iowa Wildlife Action Plan. <www.iowadnr.gov/wildlife/diversity/plan.html>.
[24]Iowa Gap Analysis Program. <www.gis.iastate.edu/gap/terra/IA_Report.pdf>. January 10 2009.

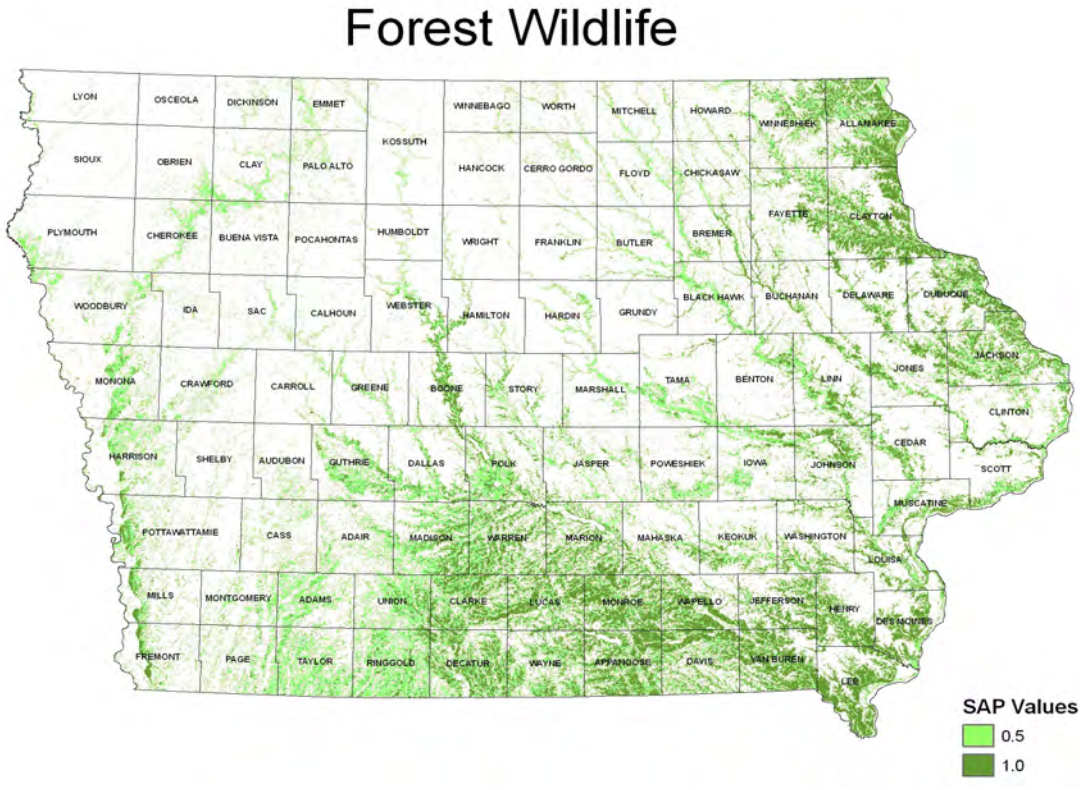
such as thinning, removal of undesirable tree species, manipulation of woody plant understory, timber harvesting, and tree planting is a key to creating better habitat.

A variety of data resources were utilized for the selection of SGCN, including:

- Iowa GAP -completed in 2003 with ongoing updates provided by Iowa Nature Mapping;
- Published historic and scientific literature;
- Unpublished reports, scientific surveys and databases maintained by the IDNR fisheries, wildlife and water quality bureaus;
- Personal research and survey data supplied by wildlife ecologists at Iowa educational institutions;
- Museum and personal specimen collections;
- State and regional databases maintained by other conservation organizations (e.g. NatureServe, PIF, PARC, TNC, USFWS, IOU, Audubon IBA, etc.);
- Personal expertise of working group members and consultants.

The procedures used to identify SGCN are elaborated on in Chapter 3 of the Wildlife Action Plan. Figure 1.56 shows a comprehensive map that prioritizes forest habitat for SGCN; areas with 7 to 13 SGCN were given a value of 0.5 and those with 14 to 38 were given a value of 1.0.

Figure 1.56 Priority Habitat for Forest Wildlife Species of Greatest Conservation Need as Determined by Iowa's Wildlife Action Plan.



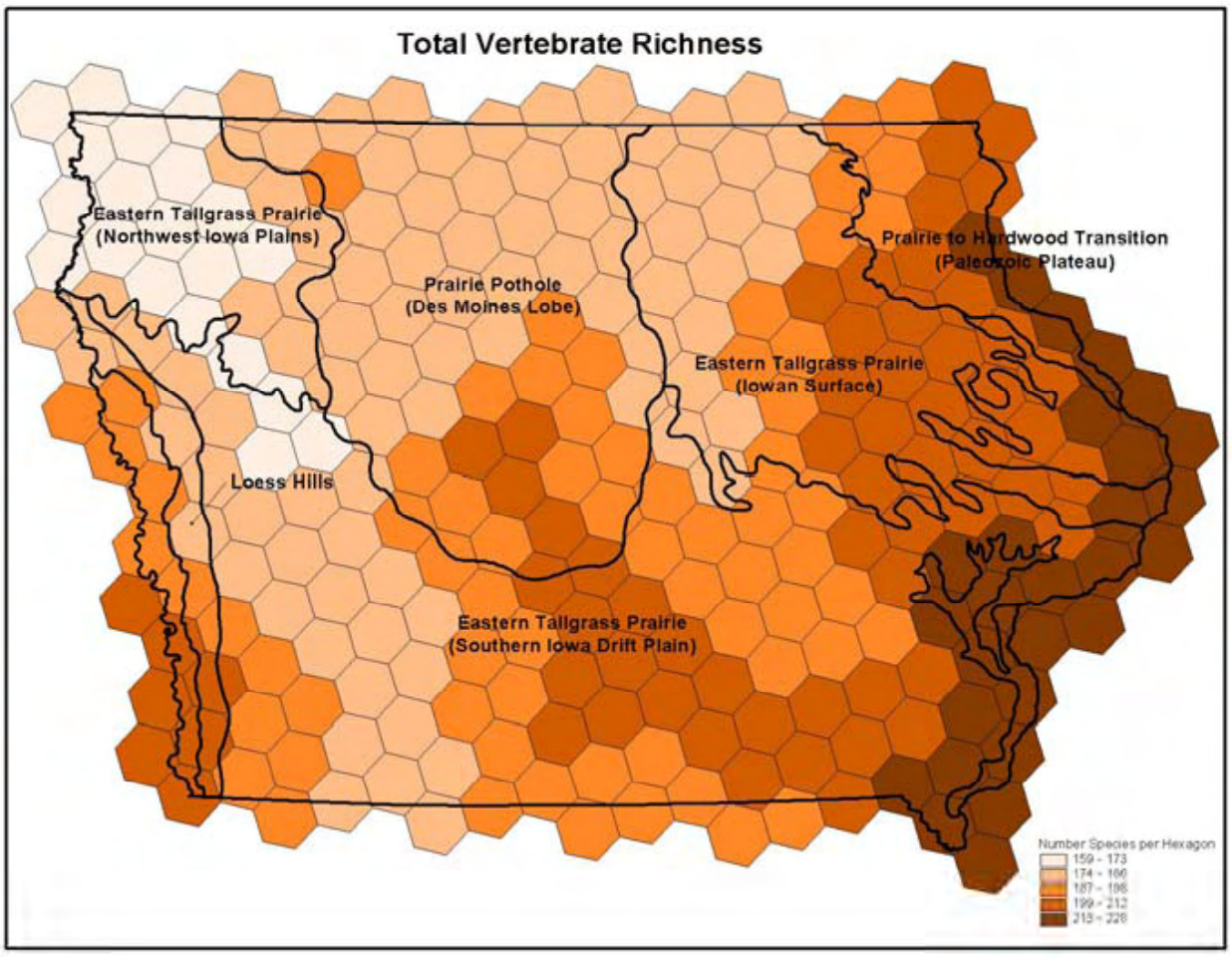
Source: Kathryne Clark using satellite land cover from 2002 and wildlife data from DNR Wildlife Bureau.

Nearly all SGCN are non-game wildlife negatively impacted by lack or degradation of suitable habitat. The table in Figure 1.63 shows that nearly one third of all the wildlife in Iowa is in need of some conservation action.

The statewide wildlife diversity map is based on individual habitat models for 288 species also included in the Wildlife Action Plan. Individual species richness maps are provided for birds (170 modeled species), mammals (53 species), reptiles (44 species) and amphibians (21 species) (see Figures 1.58 through 1.62). Although these maps do not show distribution predictions for all Iowa wildlife species included in the Wildlife Action Plan, they can be used as indicators of regions of species richness for SGCN. Some SGCN may have specific habitat requirements or limited distributions that are not found within species rich portions of the state. The special needs of these animals must be considered when specific management plans are prepared.

The species richness maps show the general distribution of existing wildlife habitats. The eastern and southeastern regions of the state and the southern Loess Hills have the greatest total species diversity (Figure 1.57) and the greatest diversity of birds (Figure 1.57), reptiles (Figure 1.59) and amphibians (Figure 1.60). This may be because the substantial portions of the state's remaining woodland habitat contained in these regions serve as major migration corridors for birds. Diversity tends to decline moving northwest into the agriculturally-dominated part of the state.

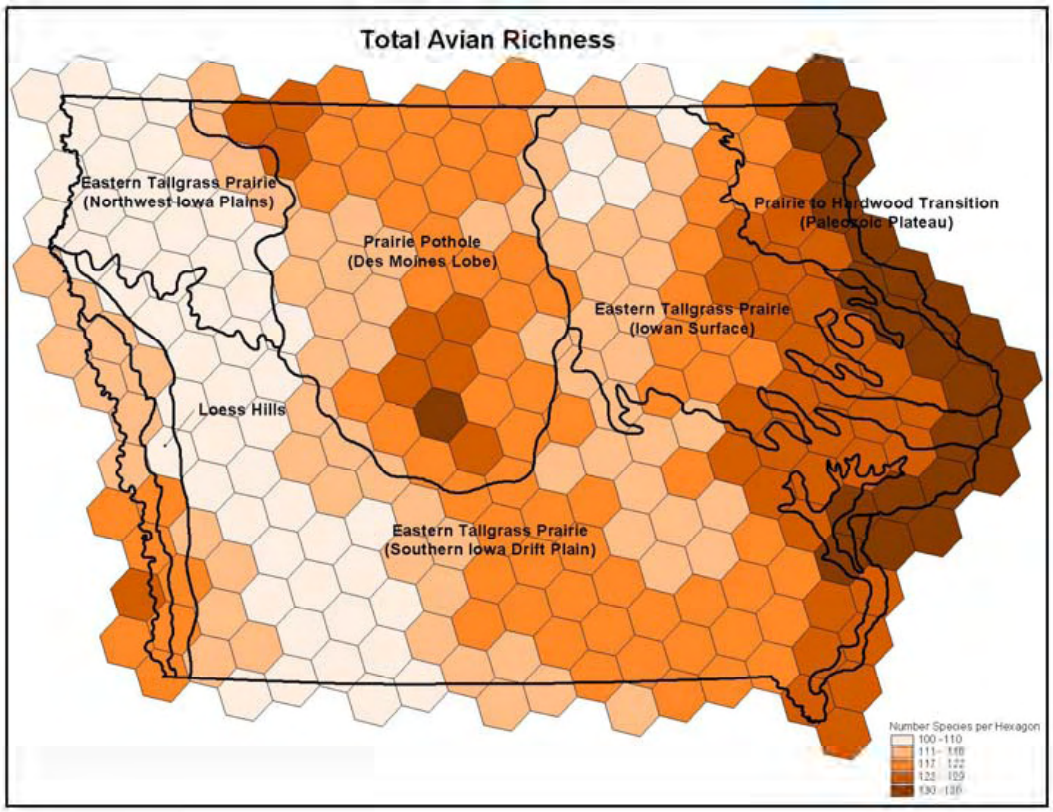
Figure 1.57 All Terrestrial Vertebrate Species Richness.



Source: Iowa GAP.

Figure 1.58 shows that avian richness is greatest along the Mississippi river, and steadily declines the further west one moves; those areas of richness that are contained within the central and western parts of state are generally found along larger river corridors.

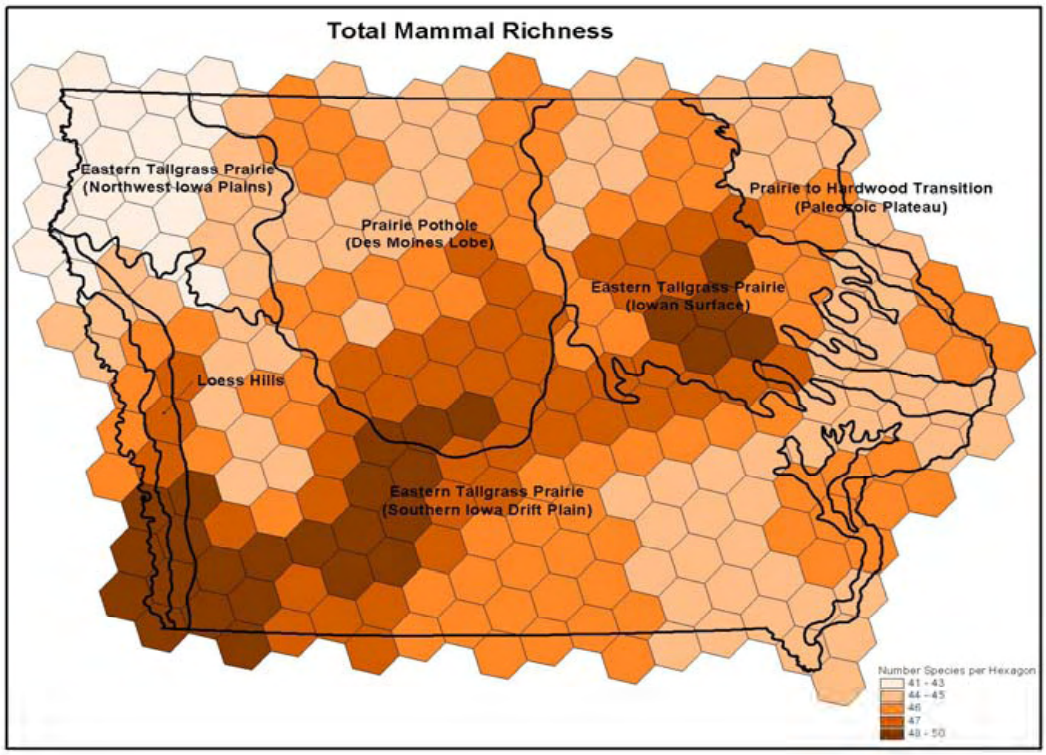
Figure 1.58 Avian Species Richness.



Source: Iowa GAP.

Figure 1.59 shows that mammal habitat is richest from the southwest to the northeast part of the state, and poorest in the northwest part.

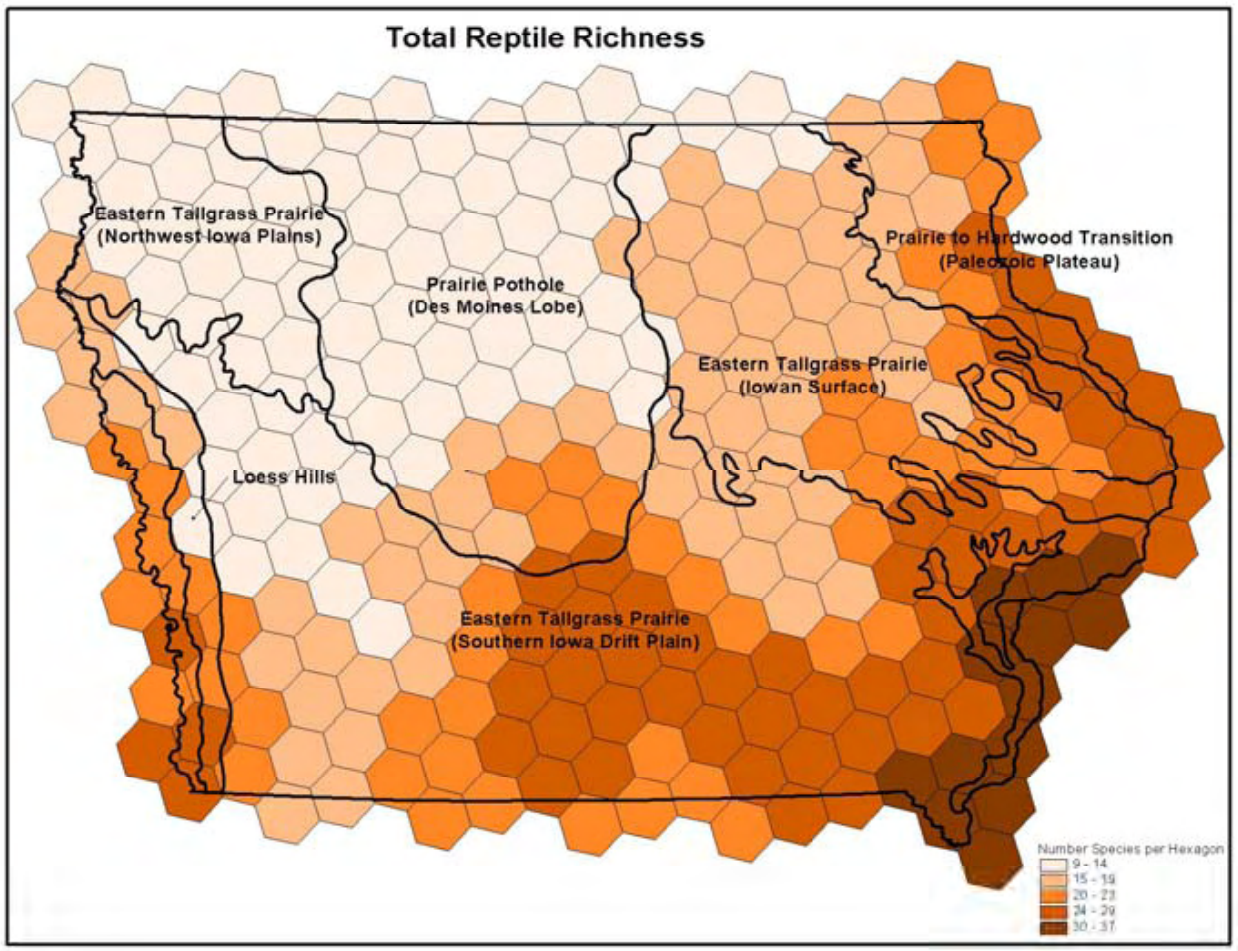
Figure 1.59 Mammal Species Richness.



Source: Iowa GAP.

Figure 1.60 shows that desirable reptile habitat is greatest in southeast Iowa and declines steadily moving northwest.

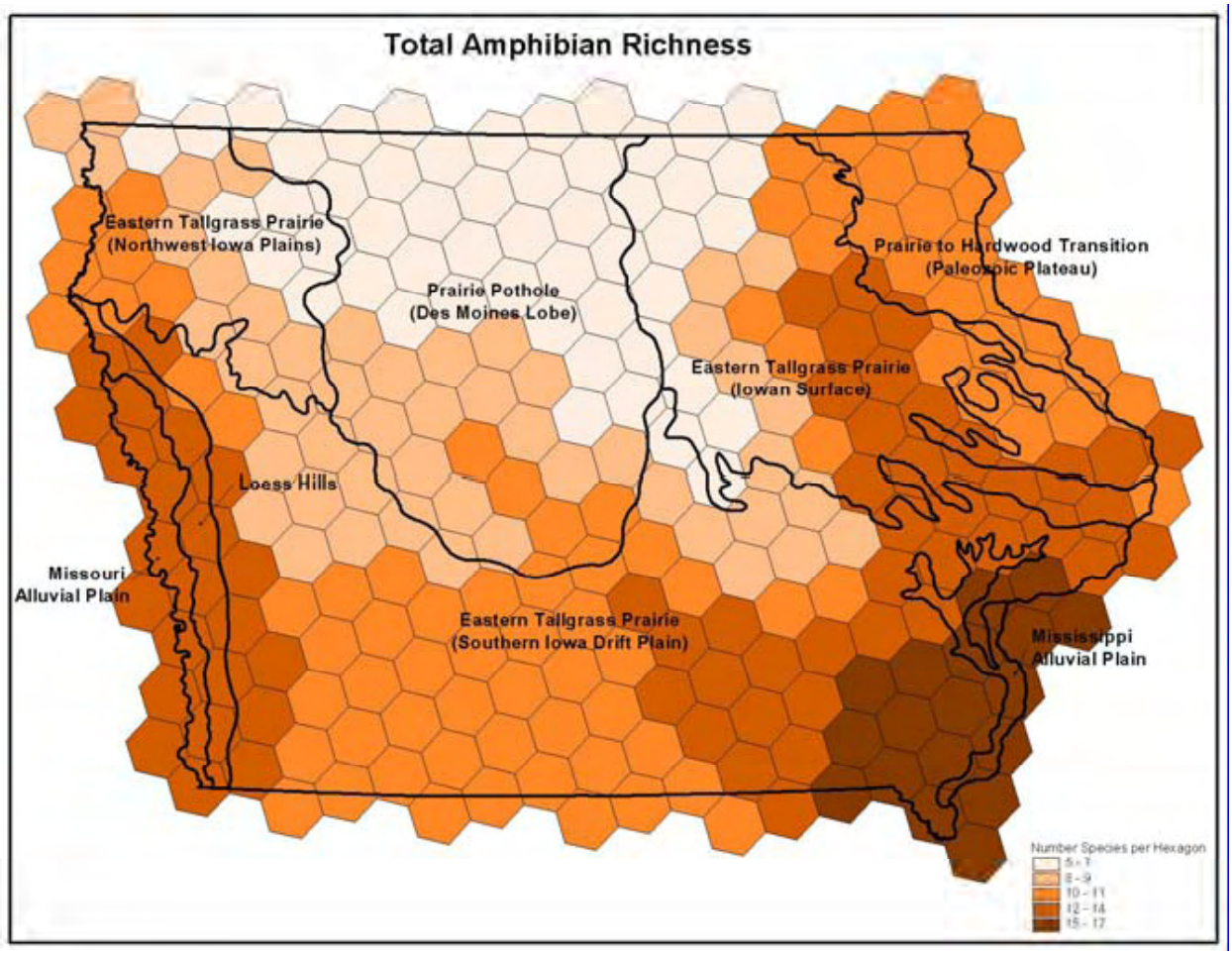
Figure 1.60 Reptile Species Richness.



Source: Iowa GAP.

According to Figure 1.61, the best amphibian habitat is in the southeast corner of the state as well; habitat is fairly rich along the eastern, southern, and western borders of the state and comparably poor in the northern prairie pothole region.

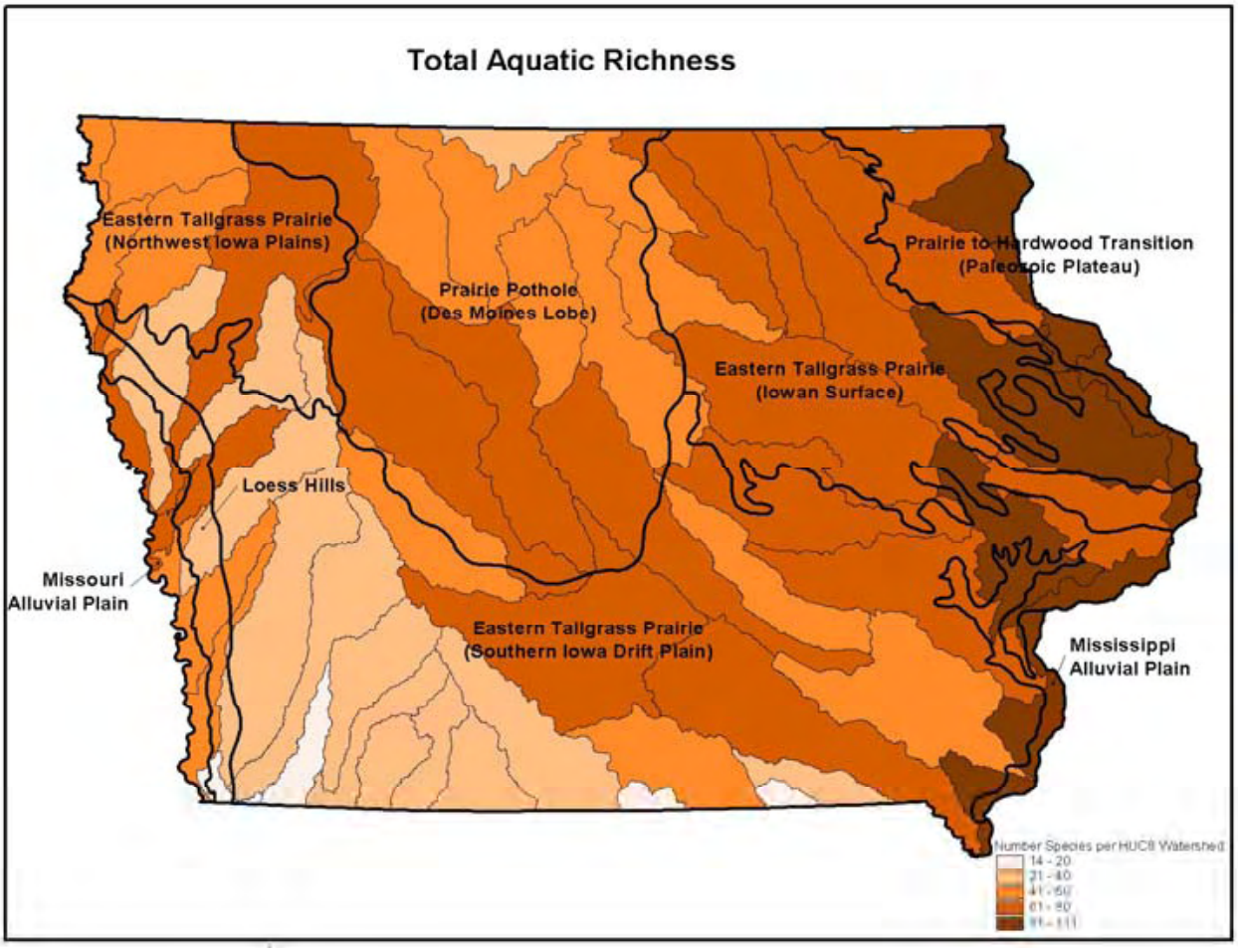
Figure 1.61 Amphibian Species Richness.



Source: Iowa GAP.

Figure 1.62 shows that the most desirable aquatic habitat exists in the eastern part of the state. The state has a relative abundance of aquatic habitat throughout, with the exception of western and southwestern Iowa.

Figure 1.62 Aquatic Species Richness.



Source: Iowa GAP.

While these maps show general areas of species richness, there is still much to be learned about the actual distributions and abundance of SGCN within these regions; the needs of these species cannot be fully addressed until comprehensive inventory and monitoring begin to take place.

Forest-associated Species of Concern by Taxonomic Group

Nearly all SGCN are non-game wildlife negatively impacted by lack or degradation of suitable habitat. The table in Figure 1.63 shows that nearly one third of all the wildlife in Iowa is in need of some conservation action.

As Figure 1.63 demonstrates, forests provide habitat for a number of SGCN species, including 74 bird, 19 mammal, 19 reptile and amphibian, 12 butterfly, and 8 land snail species.

Figure 1.63 SGCN according to the IWAP.

Taxonomic Class	Species Considered	Number with Greatest Need	Percentage of Group Total
Breeding Birds	206	67	33
Migrant Birds	199	18	9
Mammals	88	18	22
Fish	153	68	44
Reptiles & Amphibians	71	31	44
Freshwater Mussels	55	29	53
Land Snails	8	8	100
Butterflies	113	30	25
Dragonflies & Damselflies	106	28	26
Total Species Considered	999	297	30

Source: Iowa Wildlife Action Plan.

Common wildlife trees in Iowa include oaks, hickories, persimmon, mulberry, hackberry, dogwood, serviceberry, honey locust, and black cherry. Oaks, the most important of these, produce acorns, which are an important winter food supply for wildlife in forested areas, including foxes and channel catfish. There are two groups of oaks in Iowa, the white oak group and the red oak group. Acorns in the white oak group ripen in one growing season, while those in the red group ripen in two years. The availability of acorns from two sources, rather than just one, means that complete acorn failures are rare, though they do occur from time to time.

Forest Bird Richness

Within the last two decades, alarming declines in many species of North American birds have led to the emergence of national and international initiatives dedicated to the conservation of game and non-game birds; various programs are gathering under the umbrella of North American Bird Conservation Initiative (NABCI) to conserve all birds in all habitats. As part of this initiative, and in an effort to protect dwindling populations of Iowa birds, Iowa's Bird Conservation Area (BCA) program was established by the DNR Wildlife Bureau in 2001; Figure 1.64 shows Iowa habitat areas that meet BCA requirements.

What is a BCA?

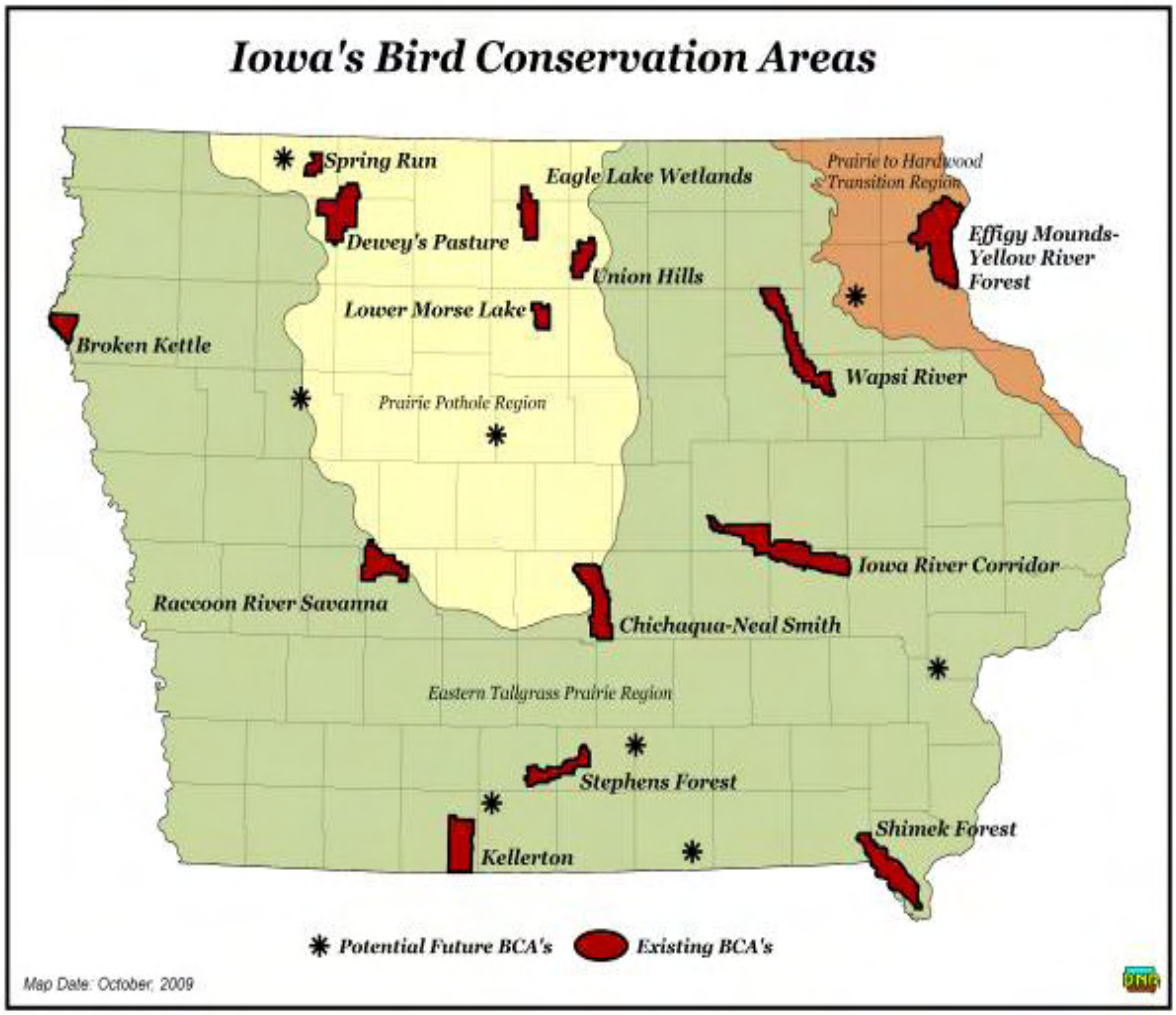
The Bird Conservation Area concept was first proposed by the Midwest working group of Partners In Flight (PIF) as a way to maintain populations of breeding grassland birds; this guideline has since been expanded to include birds breeding in a variety of habitats, including grassland, wetland, woodland, and savanna. This approach is backed by research suggesting that in order to maintain viable bird populations, conservation efforts must be undertaken at a landscape level. Through cooperation with private landowners, private conservation organizations, and other government agencies, the Iowa DNR is making progress in its efforts to develop BCAs.

There are several criteria for the ideal BCA: first, it should encompass at least 10,000 acres of

public and/or private lands, approximately 25% of which is grassland or some other type of key bird habitat. Another important factor is the existence of a "core" area of protected high-quality habitat that is at least 2,000 acres in size. This core should then be surrounded by a mix of private and public lands that are either ideal for bird habitat or, at the very least, neutral in their effects on birds. Finally, these outlying parcels should contain at least 100 acres of contiguous targeted habitat in order to provide a "matrix" of quality habitat; reducing the fragmentation of forest cover in these areas is one way to meet this last objective.

Bird watching, or birding, is one of North America's fastest growing pastimes, with an estimated 50 to 70 million participants in the United States. Partly in response to the growing popularity of birding, expenditures for wildlife monitoring have grown in the U.S. by 46% since 1991. Special highway and recreational area maps guide birders along "birding trails," and bird festivals and guided birding field trips are growing in popularity. The economic affects of birding in the state are significant - for example, a recent survey by the U.S. Fish & Wildlife Service found that the million or so people who engaged in wildlife viewing in Iowa in 2006 contributed on additional $304 million to the state's economy. One of the many benefits of BCAs is that they may draw even more bird enthusiasts to the state, which would lead to an even greater increase in wildlife-related revenue.[25]

Figure 1.64 Iowa's Bird Conservation Areas.



Source: Kathryne Clark using landform regions of Iowa and wildlife data from DNR Wildlife Bureau.

[25]<dnrdeve.iowa.gov/wildlife/files/BCA_index.html>. March 9 2009.

1.5 Highlights for Conservation of Biological Diversity

Many of the problems facing Iowa's forests are a result of conversion of forest land for other uses such as community development and agriculture.

If managed at full stocking levels, Iowa forests could be growing a 47% greater volume of wood.

Iowa has lost 3.6 million acres (56%) of its forest during the last 160 years.

As the state's population ages, its forest land is likely to broken into even smaller parcels as it is sold or handed down to younger generations (approximately 12% of privately-owned forest land is expected to change ownership in the next 5 years).

At present, only 9% of Iowa's land is publicly-owned; as more people gravitate to urban areas, increased pressure will be placed on the limited amount of land available for public use.

Over 90% of the forest land in Iowa was privately owned; however, the ratio of district foresters to forest landowners decreased dramatically from 1:5,500 in 1990 to 1:9,200 in 2008, making it more difficult to service landowners.

If managed at full stocking levels, Iowa forests could be growing a 47% greater volume of wood.

Over the last 160 years, the Southern Iowa Rolling Loess Prairie eco-region has lost more than 1.1 million acres of forest, the greatest number of acres of any eco-region in Iowa, while the Paleozoic Plateau has lost 47%, the highest percentage.

Tree inventories and detailed management plans are critical for helping communities better manage their tree resources.

Few communities in Iowa have a dedicated forester or arborist to manage their tree resources.

Available nursery stock must be improved so that residential tree plantings, carried out for the purpose of long-term community tree resource improvement, are best able to adapt to site conditions and withstand threats from insects and diseases.

More than 60% of Iowa communities have less than 5% urban tree cover.

Row cropping is the most common use of land in watersheds that provide communities with surface water for their drinking water supplies.

Iowa lost 11% of its oak hickory forest between 1990 and 2008 due to lack of disturbance and lack of active management on private and public forest land.

While roughly 2 million acres of forest in Iowa are classified as edge forest, only 770,000 acres are classified as interior forest.

The average number of forest acres owned by private landowners has decreased dramatically since the middle of the 20th century, from 45 in 1954, to 31 in 1990, to only 17 in 2003.

Policies that promote conservation on marginal soils or land along water corridors lead to increased tree plantings; conversely, policies that promote expansion of crop production to meet growing food and energy demands lead to decreased tree planting.

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Forest landowners are becoming increasingly less dependent on their forest resources for meeting their day-to-day survival needs.

The State Forest Nursery is one of the last nurseries in Iowa to provide genetically diverse native plant material that can best withstand future forest health problems.

More genetic conservation of biological diversity could be achieved with better funding.

Forestry practices account for only slightly more than 1% of the conservation programs funded by the NRCS in Iowa.